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NEW YORK • SAN FRANCISCO • LONDON

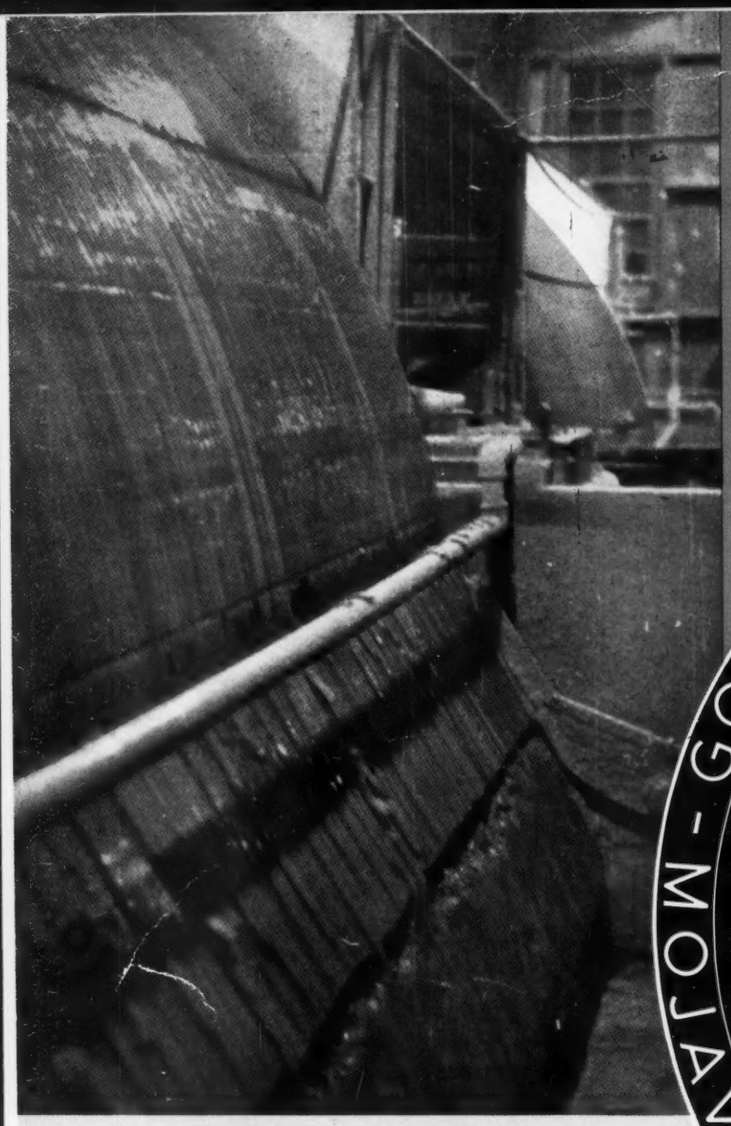
FEBRUARY, 1940

In this issue

THE 71st ANNUAL SURVEY AND OUTLOOK NUMBER

Also The New 28 x 40-in. Wall Chart of E. & M. J. Metal Prices and Production Statistics

Complete Contents on page 37



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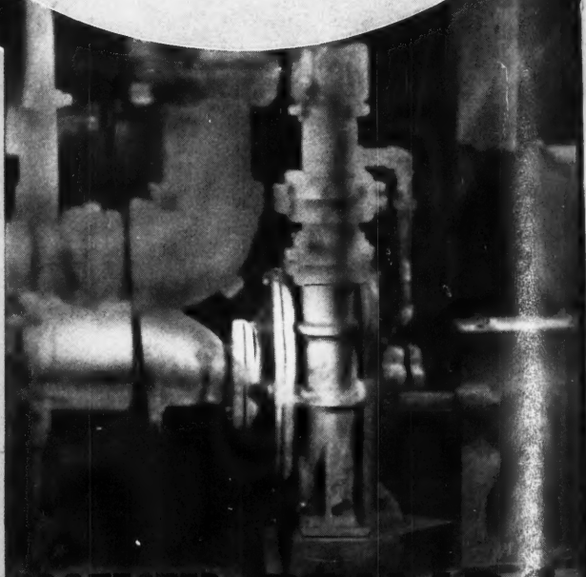

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Conveyors replacing motor-haulage and gravity methods in cave-mining practices underground will revolutionize the latter, in the opinion of Mark A. Smith, who will present his ideas in an early issue. By their means, preparatory work will be reduced to a third of that required for the multiple-branch-raise method, he thinks, and it will be possible to draw large areas rapidly and uniformly and to measure accurately the ore drawn at each point.

▼

Sand and gravel for the projected work of the Shasta Dam, in California, are to be transported by a series of 25 36-in. conveyor belts a distance of 9.6 miles, instead of by truck or railroad. It is estimated that 22,500 tons will be moved every 24 hours. This, it is said, will be the world's longest conveyor system.

▼

Tin may be "polished" for microscopic examination by Jacquet's electrolytic method. According to the International Tin Research and Development Council's quarterly review, "Tin and Its Uses" (No. 3, October, 1939), the specimen to be etched is made the anode in a concentrated mixture of perchloric acid and acetic anhydride or acetic acid. With a cast surface a high polish may be obtained in three to four minutes; with a roughly drawn surface 40 minutes may be required. The ordinary technique for polishing metal specimens has disadvantages in the case of tin because of the softness of the metal.

▼

Use of pumice in the dome of the Pantheon, at Rome, and in the immense vaults of many of that city's public baths has been revealed by the versatile Bureau of Mines, of Washington, D. C., delving into history. Three- to six-inch fragments of the rock were "poured" as a layer of aggregate in building these ancient concrete structures, and over and around them a second layer of the cement mixture of lime and puzzolanic material was poured. Thus the Romans turned this light material to good account.

H. C. PARMELEE
Editorial Director

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

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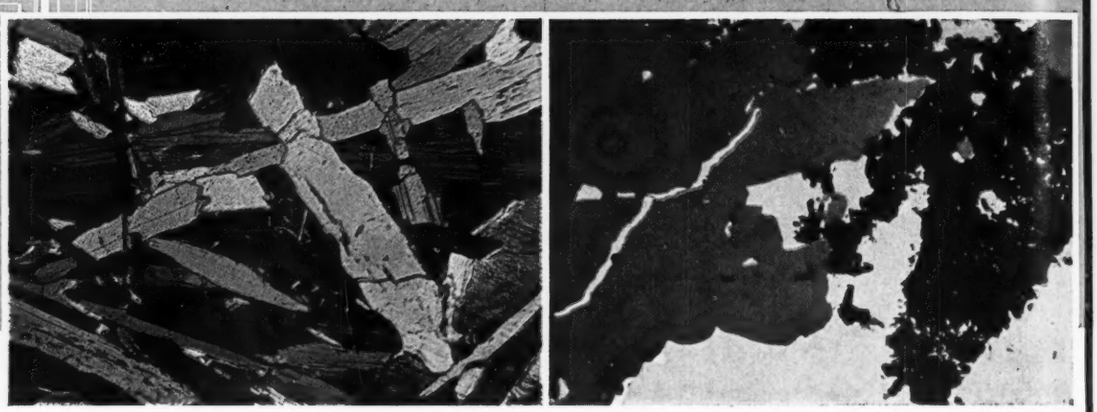
AMERICAN CYANAMID COMPANY
RESEARCH LABORATORIES

BEHIND THESE DOORS



So valuable has microscopy become that today every ore sample submitted to the Cyanamid Ore Dressing Laboratory is sent first to the Microscopical Division for examination, study and report. With this information Cyanamid Ore Dressing Engineers can then attack problems with the greatest possible efficiency. Often, microscopical examination of samples from a new ore body shows values that cannot be recovered economically or satisfactorily by conventional methods . . . in which case the organic, physical and colloid chemists of the Research Division are called in to help solve the problem.

Cyanamid Ore Dressing activities are not, however, limited to the solution of problems arising out of the development of new ore bodies. Operating concentrators are continually presenting their metallurgical problems for check-up. Often unsuspected changes in the character of the ore as revealed by the microscope necessitate revision of the existing flow scheme. Just as frequently examination shows no possibility of improving present recovery, confirmation of a job well done in a far-away mill.

Sensing the future importance of microscopy as the foundation of good metallurgy, the Cyanamid Ore Dressing Laboratory has for years been adding to its specialized personnel and improving its equipment for this intricate work.

AMERICAN CYANAMID COMPANY

Review and 1939 Outlook 1940

ENGINEERING AND MINING JOURNAL

H. C. PARMELEE, Editorial Director
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Volume 141 FEBRUARY 1940 Number 2

ANY APPRAISAL of mining activity in 1939 must distinguish sharply between conditions prevailing in the first and the last six months of the year. Broadly speaking, production and demand were subnormal in the first half, and prices were low. Opposite conditions marked the last half and were responsible for the year's high records. In fact, the annual rate of production of many metals in the last quarter of 1939 was the highest ever known. Non-ferrous metal prices rose gradually throughout the year.

GOLD mining continued to enjoy its unique prosperity in 1939 and registered a new high record in production and value, as it has annually since 1926. In the past fifteen years the annual gold production of the world has more than doubled. The United States Treasury continued to add to its gold reserves, now valued at $17.7 billion, an increase of $3.2 billion in 1939. The future of gold becomes more problematical as time goes on, and producers should read carefully our correspondent's review of the subject. Silver production in 1939 was less than in the preceding year, declining in the United States and other major producing countries. Uncertainty of the future marked the domestic scene during the first of the year, and led to federal legislation in July of a statutory price of 71.11¢ per ounce. Treasury accumulaton of silver was less than in 1938.

NON-FERROUS METAL PRODUCTION in 1939 increased over that of the preceding year, both for the world as a whole and in the United States, but lead alone surpassed the record of 1937. In fact, it almost reached the peak of 1929. A phenomenon observed in both base and precious metals was the marked increase in the aggregate production of countries of minor importance. The United States had a large export trade in copper in the latter part of 1939, Japan and Russia being heavy buyers. Lead pursued a normal, steady course, with business confined mainly to the domestic market. Zinc producers, affected by tariff reduction in the Canadian trade treaty, had to meet the competition of substantial imports.

SEVERAL POLITICAL INCIDENTS of importance to mining happened in 1939. The Government inaugurated its policy of providing for the Army and Navy stockpiles of certain strategic metals and minerals. Conflict arose between a group advocating purchase of domestic products and those who felt that foreign ores only could meet the rigid specifications. The controversy still continues. Moral embargoes were laid on exports of some minerals and metals to Japan and Russia, and the full effect of that action is not yet in sight. The State Department, yielding to protest, decided not to consider reduction of the excise tax on copper in its negotiations with Chile, but gave no reconsideration to protests on zinc.

THE MINING OUTLOOK for 1940 is not crystal clear. War always leaves a wake of uncertainty in its course, and this strangest of wars in Europe is no exception. Trade and commerce are disrupted, and conditions are not likely to improve with the prospect of intensified military activity in the spring. What happens then must have its repercussions even in the United States. A temporary boom in fabricated metal products, particularly copper, may result here; but our non-ferrous metals will not be in demand, as in 1914-18.

IN THE DOMESTIC ECONOMY a mild recession, not unexpected, has already set in. Metal prices have weakened somewhat and production may be slightly reduced in the near future. But, as pointed out in our January number, the prospective pattern for 1940 business is fair, with war and politics the uncertain factors.

A CHART OF *E.&M.J.* METAL PRICES is published as a supplement to this issue of *Engineering and Mining Journal.*

GOLD

Uncertainty surrounds the question of the future value of the precious metal and its use as money. The rapid growth of America's hoard gives cause for concern

BY A CORRESPONDENT

Washington, D. C.

NEW RECORD GOLD OUTPUT was again registered in the year just closed. Preliminary estimates given in Table I indicate that world production in 1939 amounted to approximately 40,000,000 oz., a 7 per cent increase over the record for 1938. The increase was apparently not attributable to the higher prices received by operators in the important British Empire producing countries following the outbreak of war. It was a continuation of recent trends.

Prices received by British gold producers did not rise equally in all parts of the Empire. Although the official buying price in the United Kingdom was fixed early in September at 168s. an ounce, 14 per cent above the 148s. level that prevailed earlier in the year, South African producers will for the time being receive only 150s., the remainder of the higher sterling price being retained by the Government. Australian producers fare somewhat better, receiving the equivalent of 156s. sterling per ounce, or about 5 per cent more than before the war began. In Canada, which has the second largest output in the Empire, mine operators have been allowed the full benefit of the 10 per cent increase in the Canadian gold price, now about $38.50 (Canadian) per ounce.

Under conditions such as those of recent years, these higher prices would bring conflicting influences to bear on the volume of gold output. They would gradually stimulate expansion of mine capacity through increase in scale of operations of existing properties and the opening of new mines, but they would also tend to reduce the output of existing plants by inducing operators to mill ore of lower grade.

War, however, has created new conditions. Costs, for example, are likely to rise more steeply than they otherwise would. This will to some extent be offset by official action. The South African and Australian Governments will indemnify producers against the effects of increased costs by allowing them higher net prices for their gold as costs rise. On the basis of the present official sterling price for gold, costs may rise substantially in these countries without adversely affecting profit margins. Mine operators may, however, find it increasingly hard to obtain labor and supplies in competition with producers of other goods. The extent to which these difficulties will be allowed to interfere with mining will depend largely on the policy of the British Government, which has assumed wide control over the production and distribution of essentials.

The proviso regarding the marketability of gold is rendered necessary by developments in recent years. A decade ago gold was a much-wanted article, and economists were worried about a possible shortage. Now, concern over the redundancy of gold holds the spotlight. This is partly because of the tremendous increase in the quantity and value of new production and partly because of the mark-up in the monetary value of gold reserves throughout the world. Concentration of gold in certain countries, notably the United States, has created serious problems of monetary control. These were the principal facts behind the gold scare of 1937, which was discussed in these columns last year. Subsequent onset of business recession, by removing immediate fear of price inflation, pushed the so-called gold problem into the background, but the outbreak of war seems destined to bring it again to the fore. Gold's future depends upon whether the present war caps the climax to the disintegration of the gold standard that began with the last one.

The old gold standard was a monetary system in which fixed weights of gold were used as money. Gold had one essential, though not unique, quality that made it particularly suitable for use as money—its scarcity. Like everything else, money must be neither too abundant nor too easy to obtain if it is to retain its value. On the whole, gold fulfilled these requirements. In fact, it fulfilled them so well that other forms of money, such

Table I—World Gold Production

In Fine Ounces

	1939*p*	1938	1937
Principal gold producing countries			
North America	11,961,000	10,738,000	9,746,000
United States (inc. Philippines)	5,592,000	5,090,000	4,805,000
Canada	5,324,000	4,725,000	4,096,000
Mexico	1,045,000	923,000	845,000
South America	888,000	815,000	715,000
Colombia	558,000	521,000	442,000
Chile	330,000	294,000	273,000
Russia	5,250,000	5,255,000	5,255,000
Africa	14,464,000	14,154,000	13,596,000
South Africa	12,361,000	12,161,000	11,735,000
Rhodesia	772,000	815,000	808,000
West Africa	837,000	705,000	621,000
Belgian Congo	494,000	473,000	432,000
Asia and Oceania	2,077,000	2,013,000	1,713,000
Australia	1,771,000	1,692,000	1,381,000
British India	306,000	321,000	332,000
Total, principal countries	34,640,000	32,975,000	31,025,000
Other countries	5,140,000	4,237,000	3,958,000
World totals	39,780,000	37,212,000	34,983,000

p Preliminary.

as bank notes and deposits, had to be created to provide enough money to conduct business conveniently and efficiently. This was a modification of the pure gold standard, but a link was maintained between these additonal forms of money and gold, so that the physical volume of gold continued to exercise control over the volume of the total money supply. This was one essential feature of the gold standard. A second feature was that the free international transfer of gold served to settle balances due between countries at fixed exchange rates, this being an outcome of the fact that a given quantity of gold constituted a certain amount of legal tender money in every gold-standard country. The unique position occupied by gold rested on these two foundations.

For a number of decades before the World War the supply and distribution of gold were such that in most countries the volume of money was on the whole well suited to the requirements of business, and exchange rates remained stable. The circumstance was largely fortuitous, being an outgrowth of generally favorable economic conditions. But the gold standard was thought to have been responsible for the conditions that made its successful operation possible, and gold came to be regarded as possessing an almost mystical ability to create monetary and economic stability.

The war in 1914 caused a breakdown in the gold standard. Use of gold as money and for the settlement of international balances was not formally discontinued, but the familiar fixities of the pre-war era fell by the wayside. There followed a decade of great monetary disorder, with variable gold prices and exchange rates and a great increase in the amount of bank-note and deposit money in relation to gold. Gradually many of the fundamental economic causes of instability were eliminated, and in the late twenties the world found itself back on what appeared to be the fixed gold standard of pre-war days.

Significant changes had occurred, however. For one thing, the war weakened the reverence in which gold had previously been held as an automatic regulator of the supply of money. There was a desire for more flexibility and a greater measure of independent monetary control. These objectives were partly attained through establishment of the gold exchange standard in a number of countries and through the development, primarily in the United States and England, of a new central banking technique — the open-market operation. By buying and selling securities in the open market the central bank was able, within certain limits, to accommodate the supply of money to the requirements of business without regard to gold. The so-called "sterilization" of gold movements, which was criticized in

(*Continued on page* 53)

Table II—Sources of Monetary Gold Acquired by the United States January 1934–August 1939

Approximate Figures in Millions of Dollars		
Mine output		
United States	700	
Foreign (including U.S.S.R.)	5,800	
Sales from private holdings in Orient		
India	650	
Other countries	125	
Return of scrap and coin (net)		
United States	100	
Foreign	125	
Total new supplies	7,500	
Deduct estimated increase in private hoards in Western countries	500	
Net total addition to world's monetary gold stock		7,000
Changes in central reserves in foreign countries (including estimated unreported holdings)		
Decreases	3,700	
Increases	1,000	
Net decrease		2,700
Increase in United States monetary gold stock		9,700

SILVER

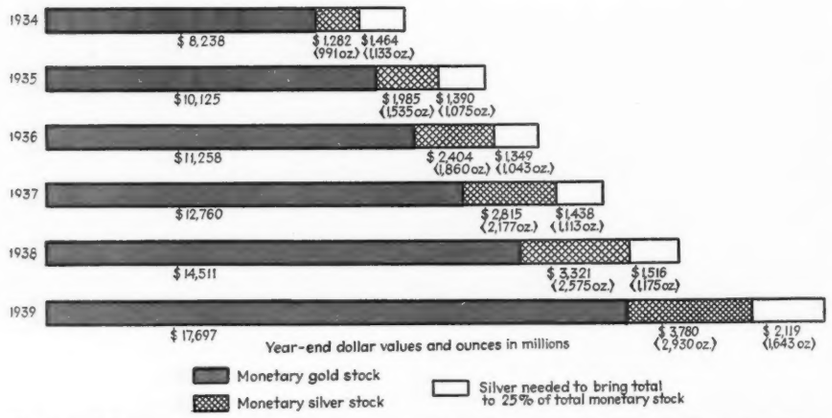
Domestic producers get new benefits. World price falls. U. S. Treasury remains chief absorber

HERBERT M. BRATTER
Washington, D. C.

WITNESSING, as it did, the restoration of "free coinage" for silver produced in American mines, without limit as to quantity or time, the year 1939 was notable in American silver history. At no time, moreover, since enactment was the Silver Purchase Act of 1934 in such danger of repeal as in 1939. Indeed, the entire silver program was subjected to persistent criticism, and the attack which developed in the Senate resulted in a lowering of the Treasury's price for foreign silver from 43c. to 35c. an ounce. In the House, the strength of the anti-silver sentiment was revealed on Feb. 28, when, by a vote of 155 to 135, that body recorded its unwillingness to repeal the 1934 act, the narrow margin taking many people by surprise.

The Administration continued cautious in regard to the domestic subsidy. In formally discussing with committees the expiring temporary gold and silver powers, the Secretary of the Treasury offered the strongest arguments in favor of retaining the Stabilization Fund and dollar-devaluation powers, but for the temporary powers under which the domestic silver subsidy was being granted he made no arguments at all. When the Senate silver bloc during the debate on the monetary bill sought to increase the domestic subsidy, the Administration's floor leader vigorously and unsuccessfully opposed such increase, and with equal vigor and more success defended the continued purchase of foreign silver.

From the viewpoint of American mine producers, the most important result of the regular session of Congress was the act of July 6, which increased the domestic subsidy and made it permanent. The silver provisions of this act leave the Administration no discretionary power over domestic silver, but opened the mints permanently to all newly mined silver of domestic origin, producers thereof being guaranteed 71.11c. an ounce (compared with a return of



Continued heavy buying of silver for five and a half years under the Silver Purchase Act left the Treasury at the end of 1939 still more than a billion ounces short of maintaining a quarter of the value of its monetary stock in silver, as the law requires

64.64c. established by the proclamations of Dec. 21, 1933, and Dec. 30, 1937.

The fixing of the subsidy at 71.11c., a Senate accomplishment, was made possible by a hurriedly made "deal" between silver-State Senators and a group that sought to deprive the President of his emergency powers over gold. With respect to the latter group's main objective, the move failed. From the viewpoint of the silver bloc, however, it was successful in that it not merely increased the subsidy but wrote it into the permanent statutes.

The act of July 6 took care of all silver mined after July 1, 1939. A certain small amount was mined on or prior to that date, but not early enough to be turned in to the Government under the proclamation of Dec. 31, 1938. By a Presidential proclamation of July 25, 1939, such silver was made deliverable to the Mint.

As already noted, 1939 marked the unveiling of critical interest in the silver program. Had the attack on it not coincided with the debate on the Stabilization Fund and the gold powers, the Silver Purchase Act of 1934 would probably have been repealed in so far as it affected foreign silver.

MEXICO—As the world's leading mine producer of silver, Mexico continued to be a major beneficiary of the Silver Purchase Act of 1934. Its policy toward American investments in turn played a part in creating American dissatisfaction with the silver program. The Washington Administration resisted the attempts to repeal the foreign silver program and Mexico on its part likewise did what it could to prevent its abandonment.

The decline in the price of foreign silver from 43c. to 35c. an ounce following the Senate's vote on June 26 to end foreign purchases naturally implied a sharp reduction in Mexico's dollar income from silver exports. It also tended to reduce the Mexican Government's revenues from the production and export taxes. To soften these adverse effects, that Government permitted the foreign-exchange value of the peso to decline from the 19.8c. average in June (selling rate in Mexico City) to 16.8c., the average for August. The outbreak of the war caused the peso to rise to an average of 20.6c. in October. In subsequent weeks the peso declined sharply and at the end of the year was quoted in New York at 17¼c.

In August, Mexico abolished the 12 per cent export duty on silver, which had been in force since August, 1938.

President Cárdenas, in his annual message to the Congress on Sept. 1, reported that the increased demand for other metals were counteracting the unfavorable consequences of the reduced price of silver, and the lower value of the peso had caused exports to increase and imports to decline.

At the Inter-American Conference at Panama, summoned as a result of the European war, the delegates of Mexico on Sept. 27 recommended that the use of silver in settlement of international balances be extended. The "final act" of the conference included a resolution containing a recommendation "to study the possibility that silver be also one of the mediums for international payment." Inasmuch as any commodity in international commerce technically may be regarded as a "medium of international payment," and as, moreover, there is no tendency for nations to revert to silver as an international currency, this has the appearance of a mere gesture.

TRADING ABROAD — During 1939 various measures taken in foreign countries tended to limit the international market for silver in one way or another, revealing the United States even more than before the outstanding absorber of the metal. Early in January the board of the Bombay bullion exchange recommended that its members abstain from importing silver. Commencing Jan. 29, the Canadian Commodity Exchange discontinued carrying the bid price, there having been no transaction in silver on that market in several months.

In February, for the first time in years, arbitrage shipments of silver from the United States to London became possible. This anomalous situation was due to the bear squeeze resulting from forward sales made in December, 1938, in anticipation of a change in American official policy. (Not until just before the outbreak of war, however, did the Commerce Department statistics show a net movement of silver to the United Kingdom in the form of exports from the United States.)

The London Metal Exchange as of April 1 discontinued official quota-

(*Continued on page* 52)

WORLD'S SILVER PRODUCTION . . . In Fine Ounces

Country	1936	1937	1938	1939
United States....	62,842,000	69,315,000	58,736,000	57,500,000
Canada.....	18,334,487	22,977,751	22,157,154	23,500,000
Mexico.....	77,462,114	84,678,921	81,016,939	76,500,000
Peru.....	19,914,482	17,175,334	20,500,000	18,750,000
Other America...	17,883,042	20,620,502	17,320,426	19,000,000
Europe.....	18,726,023	19,533,561	21,129,241	22,000,000
Australasia.....	13,191,629	14,835,821	14,939,040	15,100,000
Japan.....	9,765,237	10,000,000	11,000,000	11,000,000
India.....	6,670,000	6,880,000	6,450,000	6,500,000
Other Asia.....	3,147,978	3,853,530	4,086,522	4,500,000
Africa.....	4,730,227	5,278,103	5,597,362	5,350,000
Totals..	252,667,219	275,148,523	262,932,684	259,700,000

Refinery output. Figures for 1936, 1937, and 1938 by American Bureau of Metal Statistics; 1939 *E. & M. J.* estimate.

COPPER

War raises rate of production for world to highest level on record. Outlook uncertain

H. H. WANDERS

Market Editor
"Engineering and Mining Journal"

COPPER moved from a state of near-depression and curtailment to one of near-capacity operations, all within a year. The final accounting for 1939, notwithstanding the poor start, showed gains over the previous year in sales volume, consumption, production, and prices. World output at the end of the year was at the highest rate on record, thanks largely to the revival in activity in the domestic industry. Inventories of fabricators and ultimate consumers were increased during the last quarter, because of the uncertain future.

The major problem of the domestic industry during the first half of the year was to bring production and shipments into balance. Just as soon as it became evident that this necessary condition for a healthy market was in sight, buying interest revived. Then, in July, it was revealed that the French Government had contracted for 50,000 tons of copper from foreign and domestic producers. Prices strengthened immediately and purchases for domestic account increased. Sales in the domestic market totaled 183,151 tons for July, the first buying wave in a year. The price advanced one-quarter cent. August bookings dropped to 38,237 tons, consumers acting with reserve because of unsettlement in conditions abroad.

The European war in early September changed everything. The price moved up to 12c., Connecticut Valley. Despite repeated warnings that conditions in 1939 should not be compared with those of the World War period, buyers purchased all of the metal they could obtain. Action was taken in the United Kingdom to control prices, but this failed to check the buying enthusiasm here.

On Sept. 12, President Roosevelt issued a warning as to the rising trend in commodity prices. Singling out copper he said that plenty could be produced at 12½c. at a fair profit and the Government wanted no repetition of the World War situation. Though surplus stocks in the hands of producers had been reduced appreciably, and sentiment in most quarters remained bullish, buying due to fear gradually subsided. Early in October the producers' price rose to 12½c., and remained at that level during November and December. So-called outside metal sold at a premium, but producers controlled the price situation by allocating sales and discouraging speculation, the procedure being not unlike that followed in the lead industry.

In September, also, the Copper Institute ceased issuing foreign and domestic copper statistics, owing to incomplete returns, which injected added confusion in the market.

The import tax on copper was extended during the year to June 30, 1941. After that action was taken, in June, the industry thought that the question of the copper tax could

(*Continued on page* 48)

WORLD'S COPPER PRODUCTION . . . In Short Tons

Country	1936	1937	1938	1939
United States	614,971	834,835	553,430	745,000
Canada	210,824	262,432	290,200	303,000
Mexico	35,960	51,538	45,662	47,500
Chile	282,418	455,165	387,315	350,000
Peru	36,764	39,316	40,021	40,000
Germany	32,849	36,155	35,000	37,000
Russia	91,491	101,963	108,025	110,000
Spain and Portugal	31,127	34,546	37,964	38,500
Japan	81,350	83,665	84,877	86,000
Africa	272,183	416,328	395,400	375,000
Elsewhere	158,584	188,023	206,373	212,000
Totals	1,848,521	2,503,966	2,184,267	2,344,000

Statistics based on blister copper, so far as possible, and referred to countries wherein ore originated. Does not include secondary copper. Figures for 1936, 1937, and 1938 by American Bureau of Metal Statistics; 1939 *E. & M. J.* estimate.

LEAD

Heavy buying follows outbreak of war. Domestic mine output high. Metal's position strong

F. E. WORMSER

Secretary
Lead Industries Association

ANOTHER earth-shaking war has put its print upon the lead market. In fact, the most important single event to chronicle for 1939 is the effect which the beginning of the European conflict had upon the domestic situation. During the stirring days of September thoughts went back to 1914 for a parallel. The heavy buying of domestic lead in September was surely stimulated by the memory of the high prices which prevailed during the first world war. Examination of the behavior of lead during the years 1914 to 1918 discloses that, although there was a sharp spurt temporarily in the London market upon the declaration of hostilities, the New York price made no immediate response upward. On the contrary, it was lower on the average during the fall of 1914 than at the beginning of the present year. Not until 1916 and 1917 did the lead market really reach record-breaking heights.

The present war began soon after a revival had become noticeable in domestic demand, sufficiently great to raise the price in successive advances from a low of 4.75c. per pound, New York, in April to 5.05c. on Aug. 3, which price was maintained to Sept. 5, when it was increased to 5.25c. The next day it was advanced to 5.50c., at which level it remained throughout the remainder of the year.

Sellers of lead were overloaded with orders in September and sales reached a record high of 104,000 tons, or more than 2½ times the current output of the mines. Anxiety as to the future supply and the fact that many users had become accustomed to carrying only moderate inventories doubtless contributed to the excitement of the time. Had it not been for the existence of substantial stocks of refined lead, which were freely drawn upon, the market might easily have had one of those sharp upward spurts of short duration which are so demoralizing to the smooth conduct of

manufacturing operations. As it was, it advanced moderately to 5.50c. per pound, New York. The average for the year was 5.053c. per pound, compared with 4.739c. for 1938.

Average Yearly Price of Lead

Cents per Pound New York

1922	5.734	1931	4.243
1923	7.267	1932	3.180
1924	8.997	1933	3.869
1925	9.020	1934	3.860
1926	8.417	1935	4.065
1927	6.755	1936	4.710
1928	6.305	1937	6.009
1929	6.833	1938	4.739
1930	5.517	1939	5.053

It appears now that the rush for lead last September was merely transient. In October, November, and December, sales volume averaged only about 40,000 tons per month, less than the average mine production of 41,000 tons for the same period, which had been stimulated by the advance in price. So heavily did consumers buy in September, that stocks of refined metal in the hands of shippers dropped sharply each month for the rest of the year as sellers made delivery on their September contracts. Refined stocks declined about one-half during 1939, or from 116,000 tons on hand to about 55,000 tons—a little over a month's production.

For many years, excess stocks of pig lead, accumulated principally in the course of keeping mines operating steadily and employees busy during a period of almost continuous depression, had had a dampening influence on the market. Today sellers are in a different position, the statistical position of lead being stronger than it has been for a long time. Should the demand in the United States increase beyond the 40,000 tons per month bought by buyers during the last quarter of 1939, the lead mines in the West may have difficulty in meeting consumers' needs at present prices. As usual, price will govern the supply appearing above ground. Numerous marginal mines would resume, if given the stimulus of a price to make such reopening attractive. Higher taxes, higher wages, and new wage laws may necessitate greater inducements than might have been required a few years ago.

Mine production of lead for domestic mines was greater during 1939 than in any year since 1930, according to preliminary figures. About 460,000 tons was produced in the United States, compared with 382,000 tons in 1938. Missouri, Utah, and Idaho, as usual, were the principal sources. Some important mines in Utah that had been shut down for about a year resumed during the summer. As the year closed, most of the larger lead-mining districts were operating full scale.

Production of scrap lead, always an extremely important element in the lead market, is estimated to have increased about 20 per cent during the year because of better prices for scrap. Reclamation of old battery plates alone probably accounted for 200,000 tons of lead.

Even though world production data are incomplete, because of war conditions, to make an accurate comparison, there is no doubt that the United States no longer occupies the predominant world position it held in 1914. Then it accounted for over 40 per cent of the world output. Today the ratio has dropped to one-quarter. Meanwhile, the British Empire has grown vastly in lead production, as the table indicates.

Mine Production of British Empire and the United States

Metric Tons

	1914	1938
Canada	16,530	190,000
Australia	102,700	265,300
Burma	19,700	81,400
United States	472,100	331,500
World	1,153,000	.....

In addition, the supply of Mexican lead has increased greatly during the last 25 years. In 1914 Mexico produced 41,000 metric tons; in 1938, 282,000 metric tons. There appears little likelihood of any European nation having to draw lead for its own war and industrial needs from the United States. It would seem logical to conclude that domestic requirements will continue to govern the course of the lead market in the United States rather than a war demand abroad.

Shortly after the war began, the London market was placed under control of the British authorities, who fixed the price of £17.5s. That market thereupon ceased to have value as an independent gage of world lead market conditions. Subsequently, the price was advanced in London to £25, duty paid. It is believed that the British authorities are seeking to establish a price which will permit Empire producers to pay a fair wage and receive moderate profits, keeping their industries producing at full volume and at the same time stretching their war expenditures to buy as much as possible.

During 1939 negotiations for the renewal of the trade agreement with Belgium were announced, negotiations which carry a threat to the rate on numerous lead pigments, and the agreement is, therefore, just as important as other agreements which included consideration of the ore and metal rates. Presumably because of the outbreak of the war, no decision has been announced on the Belgian agreement. So long as the present reciprocal trade treaty policy is in effect, the lead industry will be threatened periodically with a lowering of its present modest protection.

Domestic shipments of lead totaled about 560,000 tons in 1939, compared with 422,000 tons in 1938, an increase largely accounted for in the spurt of buying by storage-battery and lead pigment manufacturers. Metallic lead products such as pipe and sheet were also in larger demand from the plumbing and chemical field. A new use for lead which appears to be growing is its introduction in machine-screw steel. Minute amounts of lead (0.2 per cent) added to the steel increase the machinability to such an extent that materially lower costs are obtained. Like the small amounts of lead in gasoline, this new use promises to grow.

Although uncertainties make any prediction hazardous, it is safe to say of lead that, as in the past, its future will depend more on general business in the United States in 1940 than on any other factor. Lead has so many diversified uses that improved business in any direction is bound to be reflected in the lead market. It enters 1940 in an unusually strong statistical position.

WORLD'S LEAD PRODUCTION . . . In Short Tons

Country	1936	1937	1938	1939
United States	400,009	469,892	379,636	462,200
Canada	184,659	205,479	204,646	196,000
Mexico	240,670	254,810	267,530	230,000
Germany	153,220	179,014	189,265	202,000
Belgium	71,793	97,002	99,758	92,000
Italy	40,588	43,520	47,741	47,000
Spain	51,344	33,069	39,683	50,000
Russia	55,997	60,627	76,059	77,000
Australia	221,121	258,415	259,771	266,000
Burma	81,936	87,024	89,712	87,000
Elsewhere	139,998	206,639	225,659	205,000
Totals	1,641,335	1,895,491	1,879,460	1,914,200

In terms of base bullion, allocated so far as possible according to country of origin of ore. Figures for 1936, 1937, and 1938 by American Bureau of Metal Statistics; 1939 *E. & M. J.* estimate.

ZINC

Tariff cut and war impact have diverse effects. The industry's basic position unsatisfactory

MARSHALL L. HAVEY

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New Jersey Zinc Company

WITH respect to any product affected by European conditions and markets, the condition prevalent in 1939 must be considered as presenting two separate situations. Upon review, the first eight months for the domestic zinc industry bear little resemblance to the September-December period. Throughout their duration the outstanding influence was the reduction of 20 per cent in the tariff on slab zinc and zinc ore which had taken effect on Jan. 1, 1939, as a result of the reciprocal trade treaty with Canada. As predicted, the change in tariff did not help Canada much tonnage-wise, but it did depress the United States price, which was lowered largely to keep out foreign supplies. Under this handicap producers of slab zinc had to work at the beginning of the year, with conditions getting worse and eventual shutdown facing many of them.

Commenting last year on the zinc industry in respect to the national defense, John W. Finch, director of the Bureau of Mines, said that a reduction in the present tariff on lead and zinc could hardly be considered in the public interest and that the maintenance of the security afforded by our ability to supply our needs should receive careful consideration. The Bureau in its annual survey pointed out the several disadvantages under which American producers operate as compared with foreign competitors. A lower average grade of ore reserves and higher wages are faced by those turning out zinc as a major product, whereas in many countries abroad zinc is a byproduct. Also, zinc production without economic justification is subsidized by certain European nations to take care of military emergencies. Thus the pressure which foreign zinc exerted on the American market is all too obvious.

For the first eight months domestic production and shipments had been almost equal, averaging around 42,000 tons a month. Domestic stocks were above normal, being about 130,000 tons. Imports included more than three times as much slab zinc as in 1938 (over 16,000 tons), and over 9,000 tons of zinc in ore. The price, depressed by its connection with London and by the lowered tariff, remained at 4.50c. from Jan. 1 until July 27, when a slight improvement in world consumption started a rise which reached 4.75c. on Aug. 8.

With the outbreak of the war consumers rushed to cover future requirements. Tightness for spot delivery resulted, and prices were bid up to 6.50c. per pound. Actually, the last 25 years have seen a radical change in the position of countries outside the United States, particularly in the British Empire, and their greatly increased smelter production now will more than likely make them independent in respect to zinc. In addition, with the Empire's price for the metal fixed, with sterling largely pegged, and with the domestic zinc

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WORLD'S ZINC PRODUCTION . . . In Short Tons

Country	1936	1937	1938	1939
United States	523,166	589,619	456,990	538,198
Canada	151,697	158,643	171,656	178,000
Mexico	35,506	40,364	41,338	43,000
Belgium	215,301	248,656	231,464	210,000
France	59,084	66,611	68,532	68,000
Germany	150,354	180,006	212,173	225,000
Great Britain	68,086	69,597	61,938	68,000
Poland	103,921	120,512	122,119	100,000
Australia	77,778	78,120	78,198	78,000
Russia	71,650	77,161	88,184	88,500
Elsewhere	185,091	209,198	219,278	226,000
Totals	1,641,634	1,838,487	1,751,870	1,822,698

Production by primary metallurgical works. Figures for 1936, 1937, and 1938 by American Bureau of Metal Statistics; 1939 *E. & M. J.* estimate.

TIN

Producers in restriction agreement get higher prices, smaller output. Statistics incomplete

E. BALIOL SCOTT

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THE OLD CORNISH SAYING about tin, that it is either "a feast or a fast," was never more strikingly exemplified than during 1939. The average London price for standard tin up to Aug. 31 was £222. 2s. 6d., compared with £189. 11s. 9d. for the whole of 1938, but the export allowables for the countries in the Restriction Agreement up to the date when retroactive increases in the third quarter were announced, were lower, if the contributions of the Buffer Pool be included. Outside producers no doubt benefited, but the improvement in price can have been of little service to countries which had to practice Restriction.

One of the chief changes was the official stabilization of prices, compared with that of output, as the declared object of the Control. What had been previously merely implicit, and indeed frequently denied, in the International Tin Control—namely, that it was primarily a valorization scheme—became the explicit object when the Buffer Pool scheme began to function. This prevented the Standard price during the year from falling below £209 (early in January), but this advantage was dearly bought by producers who had to submit to Restriction. The International quota, including Buffer Pool contribution, was 45 per cent in the first quarter, 40 per cent in the second, and 45 per cent in the third, previous to the retroactive increases, which were too late to affect production previous to the outbreak of war. The increase in price did benefit the newer signatory countries enjoying standards in excess of their capacity to produce so far. Moreover, working costs at most properties were considerably enhanced through the increased proportion of overheads.

As a price-stabilizing factor international control of tin was as unsuccessful as ever. Owing to the war, it is difficult to say what the range of prices actually was, and on a super-

ficial view it will doubtless be said that the war and not the Control should be blamed for prices reported to have run up in the United States 70c. per pound, or say £390 a ton for Straits. But if the situation be examined more closely, it will be realized that this rush to buy tin, after the outbreak of war, was due principally to the United States shortage of supply caused by the belief that the Buffer Pool would keep prices at, or below, £230 per ton for standard. As usual, the I.T.C. delayed the increase of quota too long. For the second half of the year the quota was 110 per cent, the same as in the last three quarters of 1937. This percentage of the standard tonnages represents approximately 220,000 tons annual production, assuming that outside countries show no change, and theoretically, given the continuance of current prices, this should one day be attainable. However, it took a year of such quotas to give the world 208,000 tons in 1937, and it must require far longer under current conditions to work up to such production levels — possibly longer than the period of the current Agreement. An additional reason for this conclusion is the fixing of the maximum prices in the United Kingdom, Malaya, and Nigeria at £230 a ton, a figure much below the world price. How long producers in these fields may hold back some part of their production in the belief that this discrimination against British Empire producers cannot continue indefinitely, it is impossible to say. But it appears to be operating at the time of writing.

Assuming, then, that exports will be below quota allowances for some time, the prospects of more moderate tin prices must depend largely on whether the appetite of United States consumers for the metal continues on the recent level.

Statistics of production for 1939 are clearly conjectural at present. For restricting countries we know the quotas of standard tonnages, but these cannot have been realized in the twelve months. Exports for the nine months totaled 88,662 tons. In detail, they were: Malaya, 34,430 tons; Netherlands East Indies, 16,947; Bolivia, 15,899; Thailand (Siam), 11,666; Nigeria, 4,481; Belgian Congo, 4,143; and Indo-China, 1,099 tons. As regards production by non-restricting countries, we are even more in the dark. If we estimate outside producers at around 30,000 tons, we are not likely to be very far out.

As the world's largest consumer of tin, with virtually no domestic production, the European war brought wide confusion in the United States market. Those who had a surplus stock of tin for sale held on to their supplies; consumers not well provided for scrambled for metal. Prices throughout September were largely nominal and well above the world level. The chief concern of consumers was the shipping situation. The trade attached little significance to the artificial London quotations. Tin arrivals increased toward the end of the year and the price weakened.

Outstanding in developments late in the year was the buying of tin by the Government for stockpile purposes.

During November it was announced that both the Phelps Dodge Refining Corporation and the American Metal Company are setting up plants to treat foreign tin ores, though operations for some time would be conducted on a modest scale.

World tin stocks, including tin in ore and in process at smelter, amounted to 50,407 tons at the end of December, against 50,607 tons a month previous and 49,448 tons a year ago.

WORLD'S TIN PRODUCTION . . . In Long Tons

Country	1936	1937	1938	1939
Bolivia	24,074	25,024	25,371	27,185
Great Britain	2,099	1,987	2,010	1,975
China	10,500	10,500	11,000	11,000
Burma	4,547	4,636	4,000	4,500
Malaya	66,806	77,542	43,247	55,945
Thailand (Siam)	12,678	16,494	13,520	16,991
Netherland E. I.	31,684	39,825	21,024	31,281
Nigeria	9,634	10,468	7,305	10,855
Belgian Congo	7,302	9,024	7,471	5,800
Australia	3,028	3,253	3,500	3,500
Elsewhere	8,057	9,524	9,412	9,500
Totals	180,409	208,277	147,860	178,532

Production of tin on ore basis. Figures for 1936, 1937, and 1938 by American Bureau of Metal Statistics; 1939 *E. & M. J.* estimate.

COPPER

(*Continued from page* 45)

be dismissed as settled for at least two years. However, early in October, the State Department announced that copper would be included in the items for reconsideration under a proposed trade agreement with Chile. This raised a storm of protest from domestic producers, and, in an official statement, issued Dec. 21, the Department announced that no action would be taken in the treaty so far as copper is concerned.

War turned the foreign market topsy-turvy. The London Metal Exchange suspended operations on Sept. 1 for the period of the emergency. Effective Sept. 4, the Ministry of Supply for Great Britain established full control of essential war materials. Export of metals was prohibited except under license. Maximum prices were fixed for the United Kingdom, until further notice, on the basis of £51 per long ton, c.i.f. British ports, for unwrought electrolytic copper, and £49 10s. for unwrought fire-refined.

The Ministry of Supply entered into an agreement with the Rhodesian producers to obtain the bulk of the output of that territory at a price, in pounds sterling, commensurate with the level posted for the United Kingdom. Later, an agreement was reached with Canadian producers to furnish 210,000 tons of electrolytic copper over the period of one year at a price about the equivalent of that which obtained at the outbreak of hostilities. Settlement was to be made in Canadian funds.

British authorities, on Dec. 18, posted maximum "delivered" prices for the United Kingdom. The maximum fixed for electrolytic, unwrought, was £62, with fire-refined at £61 10s., f.o.b. buyer's premises. These new quotations, so far as known here, did not disturb the contracts made previously for supplying the United Kingdom with copper.

Divorced from the world market for copper because of drastic controls, London prices ceased to be a factor in what was left of the free-trade area. The world price followed the United States market, even moving above the domestic quotation because of some urgent export business. France again entered into the picture as an important buyer and contracted for about 150,000 tons for delivery over a six-months' period, beginning with December. This tonnage was booked by South American producers and Katanga. On these large French requirements 12½c., f.a.s. American ports, was paid. Japan was an important customer during the final

quarter of 1939, and Russia also bought a considerable amount of metal.

Unlike the 1914-18 period, the British Empire now finds itself in the position of a heavy producer of copper, well in excess of 400,000 tons annually. Moreover, it is known that the Franco-British economic accord provides for eventual aid to France in respect to obtaining copper and other raw materials. Apparent consumption of copper outside of the United States remains high, but just where actual consumption stands must be left to guesswork. Large tonnages have been produced abroad in recent years and undoubtedly some countries have accumulated sizable military reserves, either in the form of raw copper or as finished products. Copper authorities believe that Germany entered into the war with large stocks. To what extent aluminum will serve as a substitute cannot be stated.

The outlook in the world market for copper for 1940 is totally obscured by the war. There may be a sudden peace, or the war may spread to all corners of the world. Whether price controls will be eased or not is another perplexing question.

Industrial activity in the United States, apart from increased war orders, has increased since June. Domestic consumption of copper rose from a low of about 50,000 tons a month in April to approximately 80,000 tons a month for the last quarter of the year. The monthly average in consumption for 1939 was about 63,000 tons, which contrasts with 45,000 monthly for 1938.

The record for 1939 in automobile production, housing and general construction, utility expenditures, and in other fields using copper was impressive, but the totals do not add up to the peaks established in the 1929 period, when copper consumption in the United States averaged slightly more than 90,000 tons a month. This is mentioned because production in the United States was stepped up sharply toward the end of 1939 and output for December, mine and scrap production, was probably in excess of 90,000 tons.

Export business involving domestic copper increased in the final quarter of 1939, adding strength to the domestic market, but at the turn of the year the foreign situation became clouded over questions raised in the minds of producers in reference to further large sales to Japan and Russia.

Though the operating rate of producers of copper may be adjusted from time to time during 1940 to meet the unpredictable conditions that the European war has created, the prospects for the year as a whole point to a fair gain in domestic consumption and a higher price level than the average for last year.

MINOR METALS

Production and consumption are greatly stimulated. Prices reverse their downward trend. Strategic commodities are given special attention in the United States

METAL ECONOMICS DIVISION

Bureau of Mines,
Washington, D. C.

THE YEAR WAS EVENTFUL for the minor metals. Improvement in industrial activity in the United States and the outbreak of war in Europe reversed the downward trend of prices and provided the markets that made possible new records for world production and consumption in several minor-metal industries. Prices in general advanced rapidly after Sept. 1, but in some instances quotations at the end of December were below the highs established in preceding months. Averages for the year will represent moderate increases over 1938 despite the many barriers to international trade resulting from the war.

In the United States interest centered in the strategic commodities of the minor-metal group—manganese, chromium, tungsten, mercury, and antimony. On June 7 the President signed the Strategic Materials Act, which authorized the expenditure of $100,000,000 over a period of four years for the purchase of stockpiles and $500,000 to be expended annually by the Bureau of Mines and the Geological Survey in an investigation of domestic resources of deficient minerals. Only $10,000,000 was appropriated for stockpile purposes, and purchases were restricted to the high-priority mineral commodities, such as manganese, chromium, and tungsten (of the minor-metal group), and tin. A broad program of reconnaissance and exploration was inaugurated by the two Government bureaus.

Domestic consumers, anticipating events that occurred in Europe later in the year, have wisely improved their stock position in recent years in some of the more vital strategic minerals, stocks of which were well above normal at the year end.

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ANTIMONY—New York quotations for domestic antimony fell from 11.75c. per pound on Jan. 2 to a low of 11.25c. late in January. In the latter part of March prices moved upward, as activity rose to higher levels. The rise stopped at 14c. late in September, a quotation that was held for the rest of the year. Prices in 1938 had ranged from 10.75 to 13.75c. and averaged 12.35c. Chinese metal was scarce, owing to the Japanese blockade of the normal trade routes from producing centers. Nominal quotations were unchanged at 14c. until late October, when they were increased to 16.50c. Imports for eleven months included 8,286 short tons of antimony ore (content), 212 tons of needle or liquated, and 1,034 tons of regulus, compared with 8,322, 90, and 821 tons, respectively, in 1938. Mexico supplied 5,532 tons of antimony in ore imported in eleven months and Bolivia most of the remainder. Receipts from China included 193 tons of liquated and 650 tons of regulus in the latter period.

Oxide-production capacity at the Laredo smelter was increased. Announcement was made that antimony oxide and electrolytic antimony would be recovered early in 1940 from the dry-belt ores treated at Bunker Hill smelter. The latter involves use of a new "Lee-Muir process," which separates the silver, copper, antimony, and bismuth components of tetrahedrite. Yellow Pine Mining Company is preparing to double its mine output at Stibnite, Idaho. The Bureau of Mines and the Geological Survey, under the Strategic Materials Act, conducted extensive drilling, trenching, and stripping operations in the Yellow Pine district of central Idaho.

No purchases of antimony were made for stockpiling under the Strategic Materials Act, available funds having been allocated to materials of higher priority, such as tin, man-

ganese, tungsten, and chromite. In October the Texas Mining & Smelting Company was said to be including in its contracts a stipulation that none of the metal shall be used for war or speculative purposes.

ARSENIC—Advance in both domestic production and imports of white arsenic in 1939 indicates a slight increase in consumption and a larger accumulation of stocks. Imports were up about 10 per cent. After the outbreak of war, increasing flow of arsenic from France was curtailed, but limited shipments from Sweden continued. Metallic arsenic imports from Germany and France (a new source) ceased after July, and prices advanced to more than 60c. a pound. In the first ten months of 1939, 5,566,319 lb. of calcium arsenate and 1,227,278 lb. of lead arsenate were exported, chiefly to South and Central America, compared with 5,242,882 and 1,021,345 lb. in 1938.

Domestic calcium arsenate consumption was slightly less than normal in 1939. That of lead arsenate probably remained the same. Activities were extended by Federal and State agencies in the use of sodium arsenite in combating pests. Domestic quotations on white arsenic continued at 3c. per pound, and the prices on arsenical insecticides remained about the same. In London the price was increased in October on foreign arsenic from £10 5s. to £18 to £20 per long ton and on Cornish arsenic from £12 to £22.

BISMUTH—The general increase in smelter activity probably explained the slight increase in domestic and foreign bismuth output. Greater demand abroad and the war's effect on shipping accounted for price increases from $1.05 to $1.10 per pound in March and to $1.25 in October. Prices of some bismuth compounds and salts also increased substantially in October. Imports of metal during the first ten months—121,485 lb.—were higher than in any year since 1922. Metal exports, chiefly to the United Kingdom, dropped slightly. It was announced that bismuth would be recovered from the dry-belt silver ores currently treated at Bunker Hill smelter.

CADMIUM—The downward trend in prices evident in 1938 continued in the first half of 1939. The New York quotation for commercial sticks, wholesale lots, dropped from 60c. per pound on Jan. 2 to 50c. on March 28. On Aug. 9 the announced price was raised to 55c. and two subsequent increases brought it to 75c. from Oct. 3 to the end of the year. In March the premium for platers' shapes over commercial sticks was cut from 25 to 5c. per pound. Imports of metallic cadmium for eleven months totaled 309,874 lb., compared with 22,582 lb. in 1938 and 828,535 lb. in 1937. Domestic production is estimated to have increased 10 to 15 per cent, but sales more than doubled those of 1938. Effective Jan. 1, 1939, the duty on cadmium was reduced from 15c. to 7.5c. per pound under the 1938 Canadian Trade Agreement.

After the outbreak of war in Europe, London prices rose from less than 2s. late in August to 5s. 6d. at Dec. 31. Empire supplies were reported adequate for all essential needs. Germany is reported to have restricted the use of cadmium in pigments.

CHROMIUM—During the first half of 1939 the chromite market was uneventful. Imports for seven months were 146,009 long tons, compared with 288,789 tons for the same period in 1938. Nominal price quotations were unchanged from the last quarter of 1938 at $23 to $24 per long ton for good-grade metallurgical ore. During the last five months, however, the steel rate rose abruptly to 93 per cent during November, and chromite was needed in greater tonnage. Quotations rose to $25 to $26 per ton in October, but consumers' stocks cushioned the effect of the sharp increase in demand. Imports for August to November, inclusive, were 127,474 long tons, compared with 56,608 tons for the corresponding period of 1938, scarcity of ships and high ocean freight rates due to the war restricting ore movement somewhat. Export restrictions were placed on chromite from some of the principal world sources.

Further attention was focused on the development of domestic production. Although output was small (several thousand tons), known deposits were being examined by private concerns and Government agencies. Under the provisions of the Strategic Materials Act, three deposits were investigated (Sweetgrass and Stillwater Counties, Mont.; Casper Mountain, in Wyoming; and near John Day, Ore.).

Of interest were the purchases of metallurgical chromite for emergency stockpiles under the aforesaid Act. Two awards were made by the Procurement Division of the Treasury, one to Mutual Chemical Company for 20,000 long tons of Turkish ore at $26.50 per ton, f.o.b. Baltimore and the other to Dorothea Reddy Moroney for 25,000 tons, at $33.74 per ton delivered at New Cumberland, Pa., to be furnished from now undeveloped properties on the Kenai Peninsula, Alaska. An earlier purchase of 1,801 short tons of chromite from Southern Rhodesia was made by the Navy at $20.74 per short ton. This ore, delivered in June, was supplied by E. J. Lavino & Company.

COBALT—Imports into the United States in the first ten months more than doubled those of the corresponding period in 1938; receipts of metal were 112 per cent and dioxide 92 per cent greater; ore receipts declined slightly. Imports in the first ten months of 1939 were 64 per cent more than during the record year 1937. Although United States consumption undoubtedly increased, the record importation in 1939 resulted chiefly from the building up of inventories here. Domestic quotations for metal in 100-lb. lots and oxide in 350-lb. lots, unchanged in 1938, advanced Oct. 26 from $1.36 and $1.67 per pound, respectively, to $1.50 and $1.84 per pound.

Incomplete statistics indicate a large increase in output in Northern Rhodesia, moderate gains in Canada and British India, and a slight decline in French Morocco. No data are available on Belgian Congo and Finland.

MAGNESIUM—World production probably set a record as a result of new plants built in the United Kingdom, Italy, and Japan; likewise consumption with mobilization programs playing an important part. Military aircraft construction led in consumption of magnesium alloys, but the use of high-pressure die castings as well as sand castings expanded also. Progress was made in treating magnesium alloys to provide better resistance to corrosion.

Dow Chemical Company, sole United States producer, reduced the price of magnesium from 30c. per pound (prevailing since 1931) to 28c. in March and to 27c. in August. Exports apparently decreased. The Bureau of Mines expanded its research program on the direct thermal reduction of magnesium from low-grade magnesite.

MANGANESE—War and rumors of war were the principal influences on the manganese ore market in 1939. Domestic quotations for 50 per cent ore were 30c. a long-ton unit, c.i.f. North Atlantic ports, duty unpaid at the beginning of the year, and the market weakened further in the first quarter.

Developments in Europe during the last half of the year increased demand, restricted shipping, and caused a large increase in ocean freight rates, with the result that prices in this country jumped to 50c. a unit before duty. The situation eased slightly with the close of the year. Exportation of manganese ore from the Gold Coast and British India was prohibited without license by their governments in September.

General imports of manganese ore for the first eleven months of 1939 totaled 583,148 long tons containing 286,859 tons of manganese, and im-

ports for consumption were 543,168 tons containing 268,785 tons. Of the general imports 28 per cent came from the U.S.S.R., 24 from Gold Coast, 17 from British India, 15 from Cuba, and 14 from Brazil. Of imports for consumption the Gold Coast supplied 40 per cent; U.S.S.R., 21; Cuba, 16; and British India, 14. In addition, 18,424 tons of lower-grade ore containing 5,340 tons of manganese was brought in from South Africa and used.

Activities in the domestic industry were stimulated by higher prices, the possibility of a shortage, and impending purchases by the Government, but production was of little consequence. Shipments of ore (35 per cent or more manganese) from domestic mines amounted to 28,000 long tons in 1939, compared with 25,321 tons in 1938. Purchases for strategic purposes were started by the Government late in 1939, and the first award was made to the Cuban American Manganese Corporation for 25,000 long tons at 61c. per unit. Delivery began in December. Under the Strategic Materials Act considerable reconnaissance work was conducted by Governmental agencies in areas that are known to contain manganese.

MERCURY—The mercury situation was characterized by sharp fluctuations in prices during 1939, particularly in the late months. Political tension abroad and uncertainty over the sales policy of the Franco Government in Spain were responsible for changes early in the year, and the declaration of war by the United Kingdom in September was the signal for precipitous gains for several weeks. On Jan. 2 the price was $77 to $78 a flask. On Sept. 5 it jumped to $110 and continued upward to $165 on Sept. 18, with both quotations nominal. Anticipated war need was only one factor. Abnormally low imports into the United States since late in 1937 and the failure of domestic production to make up for this undoubtedly drained consumers' stocks, and war-risk insurance rates raised the cost of shipping. Despite this, the increase was apparently overdone and prices dropped to $140 late in October and declined further to $135 in November.

The situation at the year end was improved, with domestic production and imports pointing higher. Production of domestic mines in November only slightly exceeded the 1,500 flasks recovered in both September and October and the monthly average of 1,499 flasks in 1938, but larger increases appeared to be in prospect. Imports for the first ten months were only 612 flasks, but in one week beginning late in November more than 2,200 flasks were reported entered.

Mercurio Europeo resumed combined selling of Italian and Spanish mercury in May. Beginning with Jan. 1, 1940, this metal was to have been sold by a Belgian firm.

YEARLY AVERAGE PRICES MISCELLANEOUS METALS . . .

Year	Aluminum	Antimony	Cadmium	Quicksilver	Platinum
1939	20.000	12.359	64.057	103.940	36.748
1938	20.000	12.349	98.037	75.469	35.901
1937	19.917	15.355	122.335	90.180	51.773
1936	20.000	12.240	97.789	79.917	42.926
1935	20.000	13.616	70.491	71.992	34.150
1934	23.300	8.901	55.000	73.865	36.465
1933	23.300	6.528	55.000	59.227	30.993
1932	23.300	5.592	55.000	57.925	36.455
1931	23.300	6.720	56.010	87.351	35.665
1930	23.787	7.667	(a)	115.009	45.358
1929	24.300	8.956	(a)	122.145	67.655

Quotations for aluminum, antimony, and cadmium in cents per pound; quicksilver in dollars per flask of 76 pounds; platinum, refined, in dollars per troy ounce.
(a) Not averaged by *E. & M. J.*

MOLYBDENUM—The phenomenal rise in molybdenum production was checked in 1939. Domestic output, which produces the bulk of the world supply, was off 7 per cent from the figures for 1938 and amounted to about 31,000,000 lbs. The drop was due largely to curtailment of operations by the Climax Molybdenum Company, which produced 21,750,000 lbs. of metal. Of interest in 1939 was the increase in the output of molybdenite concentrates as a byproduct from copper operations at Bingham, Chino, and Miami. Their output represented nearly one-fourth of the domestic total and more than double that of 1938.

Exports of molybdenum ore and concentrates from the United States during the first eleven months of 1939 were 37,372,912 lbs., of which the U.S.S.R. took 35 per cent; Japan, 25; United Kingdom, 20; Netherlands, 7; France, 7, and Italy, 3. No other country took as much as 1,000,000 lbs. Shipments in the first half of the year were on the low side, but improved materially within the next five months.

The State Department on Dec. 15 addressed a letter to all producers of molybdenum including this metal on the moral embargo list.

Exports from Norway for the first ten months were 624 metric tons, and production in Mexico for the first eight months was 566 tons. Of interest was the inauguration of recovery of molybdenite concentrates from the Braden copper mine at Sewell, Chile. Activity in prospecting for molybdenum was reported from Canada. Discoveries were reported at the Yangchia-Changtze properties of the Manchuria Lead Mining Company in Chingchow Province; also in the Haut-Tifnout region in Morocco.

Purely nominal domestic trade-journal quotations on molybdenite concentrates containing 90 per cent MoS_2 were 45c. per pound of contained MoS_2 throughout the year. London quotations increased from 43s. to 50s. per long-ton unit in December.

PLATINUM METALS—World production (exclusive of U.S.S.R.) probably will approximate the record output of 456,000 oz. in 1938. Production from the Sudbury nickel-copper ores in the first half of 1939 and 1938 was 165,403 and 130,077 oz., respectively. The output in South Africa in the first nine months of 1939 and 1938 was 48,100 and 49,300 oz. and production in the United States (Alaska) in 1939 probably will be slightly less than in 1938. Exports from Colombia during the first six months were somewhat greater than in 1938.

On Jan. 19 the price of refined platinum was advanced $1 an ounce to $35, and on Aug. 29 to $38. On Sept. 7 and 26 it was raised to $40 and $42, respectively, but on Oct. 19 it dropped to $40, where it remained. Palladium was quoted at $24 throughout the year, but the price of iridium ($65 to $70 an ounce in the first eight months) rose in September to $125.

Imports of platinum metals into this country during the first 10 months were 227,481 oz., compared with 145,599 in the corresponding period in 1938, and exports of unmanufactured platinum metals were 37,033 oz., compared with 29,791. Imports in 1939 were the largest recorded.

TUNGSTEN—Conditions in the Far East in 1939 continued to hamper the Chinese industry, which normally supplies a large part of the world's supply. Major producing areas in Kwangtung were reported still in Chinese hands and being extensively worked. The tungsten area in the

hands of the Japanese is small and not yet pacified. Adequate supplies are reaching Hongkong by devious routes, but the fear that Chinese supplies might be cut off has had a real influence on the market. Sales rights on Chinese tungsten were granted to the Pekin Syndicate, Ltd., a British corporation, by the Chinese Government in 1939, and it was reported that the Japanese army had granted the wolfram monopoly on any ore under its control from South China to three Japanese firms. Exports from China during nine months were 7,069 metric tons, compared with 12,354 tons for the same period in 1938. Delivery on barter agreements with the U.S.S.R. formed part of the movement in 1939.

London quotations declined during the first nine months but were stronger in the last quarter. Domestic quotations followed the same pattern and domestic scheelite was quoted at $22 to $24 per short-ton unit delivered at the year-end.

Domestic consumption jumped toward the end of the year, but imports for consumption were 904 short tons during the first 11 months, and general imports were 1,585 tons. Forty-three per cent of the imports came from China.

The domestic tungsten industry continued to increase its activities. Possible purchases by the Government in connection with the stockpile program enlarged the market and created further interest. Two Government purchases were made, one by the Navy for 245 short tons of concentrates from domestic sources at $25 per short ton unit and the other by the Procurement Division of the Treasury for 425 tons from China at $15.82 per unit exclusive of duty.

VANADIUM—Apparent consumption of vanadium was greater in 1939. Imports in the first eleven months totaled 12,667 short tons containing 3,264,715 lb. of V_2O_5, compared with 8,216 tons of ore for the same period in 1938. As in the past, all imported American supplies came from Peru.

Operations in the Paradox Valley, now the principal domestic producing area, continued at a high rate, with the roasting and leaching plant of the United States Vanadium Corporation at Uravan, Montrose County, running at capacity and treating 240 tons of ore daily. Additional milling facilities being installed include a refining unit for recovery of uranium from discarded material. Output continued from a number of smaller operators in Utah, and it was reported that activities were being revived in the Rifle district, Garfield County, Colo.

Germany is said to have developed a process for recovering vanadium from converter slags that may make that country independent of foreign supplies. Purely nominal quotations for ore remained unchanged throughout the year at 27½c. per pound of contained V_2O_5.

ZINC

(*Continued from page* 47)

market divorced from the London quotations by the war, there has been economic advantage for Latin-American and Canadian producers to ship ore here, rather than to one of the European nations, for smelting. Furthermore, neutral nations with an excess of slab zinc can sell it here to best advantage. Although figures are not yet available for the full year, the statistics for the first three months following the outbreak of the war show accelerated imports of both ore and slab zinc.

The rush to purchase subsided before October ended, but shipments remained an outstanding feature of the market. Within three months, stocks were cut in half, and on Dec. 1 were less than the November shipments. Lessened sales and increasing production, and the large imports of foreign slab zinc and zinc ore, then caused the first reaction that took place in any important non-ferrous metal since the war began. On Dec. 1 one producer of Prime Western zinc cut the price ½c. per pound to 6c. But there was no rush to buy. With consumers' inventory periods before them, it was difficult to tell whether their lack of interest resulted from confidence in the existence of an adequate supply of zinc for subsequent purchase as required, or whether these consumers of zinc were expecting to use less tonnage of the metal in coming months.

Forecasting today is more than hazardous. In looking ahead it must be borne in mind that developments, some of which have been referred to, are likely to emphasize unfavorable situations when the industry is least ready for them. Also, there is a threat in the new trade treaty contemplated with Belgium, wherein a reduction in the tariff on zinc oxide and zinc sheets is under consideration. Despite temporary periods of prosperity, the basic position of the zinc industry is not satisfactory. Governing the prospects of domestic business are the developments indirectly associated with the intensity and unpredictable duration of the war in Europe.

SILVER

(*Continued from page* 44)

tions for fine silver, reportedly as a direct result of the sharp contraction in silver dealings in recent years. The Exchange had resumed silver dealings on May 1, 1935, after an earlier interruption of 25 years.

The outstanding effect of the war on the silver market was the introduction of restrictions by the United Kingdom and India, which have given greater artificiality than ever to the "world silver market." The war caused a wide spread in the price in various markets. For example, on Oct. 7 the dollar equivalent of the London price was more than 40c. and that of the Bombay price was more than 45c., as compared with the New York price of only 35½c. Within two weeks the spread between Bombay and New York had increased to almost 13c.

Had speculative interest in silver increased, a flight from sterling into silver might have developed. This the exchange-control authorities could not countenance.

On Oct. 21 it was officially announced in London that the price of silver would thenceforth be fixed at 12:15 a.m. instead of 2:15 p.m. This change was necessitated by the earlier closing hours of the banks. Owing to the wartime necessity of restricting foreign-exchange allotments to essentials, on Oct. 25 the British Board of Trade subjected the importation of silver bullion and foreign silver coin to license. This restriction was an important event in the history of the London bullion market. The Indian Government, also, prohibited the importation of silver, except from Burma.

During 1939 the government of British India melted silver coin to supply demand in the bazaars and in the London market. Following the outbreak of war, the demand for silver in India rose sharply and the Bombay mint delivered fairly large amounts to the market at a premium of from 3½ to 4 per cent over the London price.

The Reserve Bank of India reported that rupees returned from circulation at an increasing rate in 1938-39. In that year the return flow was 126,000,000 rupees, as compared with 1,305,500,000 net during 1919-39.

In December, India was reported to have purchased about 1,500,000 oz. of silver in New York for the bazaar trade.

RESEARCH—The past year witnessed a substantial increase in the

industrial use of silver in brazing alloys and electrical contacts. The work of the American Silver Producers' Research Project led into channels that may ultimately produce results of great significance to the silver and tin markets. If silver-lined cans, one of the objectives, displace tin cans from even a relatively small part of their present field, the industrial silver requirements would be great. In May the Massachusetts Institute of Technology announced a silver stainless steel, containing ¼ of 1 per cent of silver.

STABILIZATION FUND — Some light on Stabilization Fund operations in silver was provided in 1939 by the initiation of publication of quarterly balance sheets and earnings statements. The latest such statement, covering operations through June 30, 1939, shows "profits on silver transactions" totaling $105,371.27 and "profits on sale of silver bullion to Treasury (nationalized)," $3,473,362.29. These figures compare with total profits since inauguration of the Fund amounting to $15,965,009.87. The $3,473,362.29, it should be noted, is a book profit.

The balance sheets of the Stabilization Fund disclose that between Dec. 31, 1938, and June 30, 1939, the indebtedness of the Central Bank of China to the Fund, expressed in Chinese yuan converted into dollars and secured by Chinese gold, was reduced from $48,657,070.27 to $19,180,127.56.

MONETARY STOCK—The ratio of silver to gold and silver in the monetary stock of the United States is set down in the Silver Purchase Act of 1934 at 25 per cent. Treasury acquisitions of silver and gold resulted in an increase of the ratio from 10.3 per cent in June, 1934, to 18.7 per cent at the end of 1938. In September, 1939, the ratio was 17.9. That a decline occurred despite the acquisition of $356,800,000 (monetary value) of silver is explained by the large coincident inflow of gold.

CHINA—China was an inconspicuous factor in the silver market in 1939. It continued to sell, but at a reduced rate, since it is believed that the remaining supply available to the central government, in China or elsewhere, has been practically exhausted. From Japan, which produces some silver itself and which also controls large areas of China, $3,537,000 worth of silver was imported into the United States during the first nine months.

Cuba during 1939 issued the remainder of the 20,000,000 silver pesos authorized in June, 1938. The discount on the silver peso increased from an average of 2.25c. in January, 1939, to a high of 14.50c. on Nov. 14. Thereafter it declined slightly.

GOLD

(*Continued from page* 43)

some circles as a nullification of the gold standard, was effected by means of open-market operations.

The war also brought about a less even distribution of gold. In 1913, for example, the United States held a fifth to a quarter of the world's monetary gold, counting estimated gold in circulation as well as in central reserves; by 1918 the proportion had risen to about two-fifths. The ensuing years did not restore the more even distribution of the pre-war period. In fact, the newly established gold standard functioned with difficulty in an unfriendly economic environment. Almost inevitably the struggle was abandoned under the stress of world depression. The desire of each country to work out freely and independently its own economic salvation was stronger than the already weakened ties to a particular monetary system.

Events of the past ten years have further weakened the position of gold. The rise in its monetary value and the increase in its physical output have suddenly raised it from a position of scarcity to one of superabundance, particularly in the United States. This country now holds roughly two-thirds of the world's monetary gold, largely because it has been virtually the only buyer of the tremendous supplies made available in the past half dozen years. From the end of January, 1934, to the outbreak of war, mine output, the sale of Oriental treasure, and the return of scrap and coin gold added $7,500,000,000 to available stocks, as shown in Table II. Of this amount it is estimated that about $500,000,000 went into private hoards in Western countries; and monetary reserves were augmented to the extent of $7,000,000,000.

Of this huge sum foreign countries in the aggregate acquired none; on the contrary, they lost gold. A handful of countries increased their collective gold holdings by $1,000,000,000, but another group lost $3,700,000,000. Foreign reserves thus declined $2,700,000,000 altogether, and the absorption of this gold in addition to new supplies added $9,700,000,000 to United States gold stock. Of this total no less than $3,500,000,000 was acquired during the twelve months ended last August.

During the first four months of the present war this amazing rate of growth was substantially maintained. The Treasury added still another $1,000,000,000 to its stock of gold between the end of August and the end of December, 1939. Though the United States may not long be required to buy gold at this rate, which is roughly twice the current value of new mine output, it is probable that virtually all new supplies will continue to be offered for sale to the Treasury for duration of the war or longer. This means acquisitions of $1,000,000,000 to $2,000,000,000 a year.

Increasing attention is being paid to this vast and continuing flow of gold to the United States. Subject of most comment thus far has been the effect on bank reserves. Gold is still money in the United States. Against every ounce it buys—and it takes all offers—the Treasury issues $35 in gold certificates. By a devious but none the less certain route this money finds its way into the cash reserves of banks, putting them in a position to expand credit and thus create still more money. The actual and potential supply of money is now far larger than this country needs—so large, in fact, as to threaten inflation. In the United States, and also in certain other countries, gold has now reversed its traditional role of guardian against excessive monetary expansion; gold, the erstwhile regulator, must now be regulated.

From December, 1936, to early 1938 the Treasury attempted to escape from this embarrassment of riches by ceasing to issue money against new gold acquisitions. Precedent for this radical departure from usual practice was found in the operating technique of the British Stabilization Fund, established in 1932. The funds with which to pay for gold purchased by the Fund were not obtained by issuing money against the gold in the usual way but by borrowing in the market. Similarly, the proceeds of gold sales were used to repay indebtedness. No money was created, none was destroyed by gold inflows and outflows. This was more than the sterilization of the money-creating power of gold acquisitions — it was destruction of that power.

With the outbreak of war last September the British authorities took the still more radical step of turning over to the Stabilization Fund the entire gold holdings of the Bank of England. Gold is no longer money in the United Kingdom—it is only an asset to be used in the acquisition of goods and services from any country that will take it in exchange. The present British monetary system is a far cry from that of a quarter century ago.

The experiment of the United States Treasury in cutting loose from the money-creating power of gold was taken on its own authority, not as a matter of law. Its rational character was not generally appreciated, and partly because of objections that it was a costly procedure to borrow money to pay for gold instead of issu-

E & M J
Annual Average Metal Prices 1898-1939

Year	Copper (a) Electrolytic, Refinery	Tin, (b) New York	Lead Common, New York	Silver New York	Zinc, Prime Western (d) E. St. Louis	Year	Copper (a) Electrolytic, Refinery	Tin, (b) New York	Lead Common, New York	Silver New York	Zinc, Prime Western (d) E. St. Louis
1898	12.03	15.70	3.78	58.260	4.57	1919	18.691	63.328	5.759	111.122	6.988
1899	16.67	25.12	4.47	59.580	5.75	1920	17.456	48.273	7.957	100.900	7.671
1900	16.19	29.90	4.37	61.330	4.39	1921	12.502	29.916	4.545	62.654	4.655
1901	16.11	16.74	4.33	58.950	4.07	1922	13.382	32.554	5.734	67.528	5.716
1902	11.626	26.79	4.069	52.160	4.84	1923	14.421	42.664	7.267	64.873	6.607
1903	13.235	28.09	4.237	53.570	5.191	1924	13.024	50.176	8.097	66.781	6.344
1904	12.823	27.99	4.309	57.221	4.931	1925	14.042	57.893	9.020	69.065	7.622
1905	15.590	31.358	4.707	60.352	5.730	1926	13.795	65.285	8.417	62.107	7.337
1906	19.278	39.819	5.657	66.791	6.048	1927	12.920	64.353	6.755	56.370	6.242
1907	20.004	38.166	5.325	65.237	5.812	1928	14.570	50.427	6.305	58.176	6.027
1908	13.208	29.465	4.200	52.864	4.578	1929	18.107	45.155	6.833	52.993	6.512
1909	12.982	29.725	4.273	51.502	5.352	1930	12.982	31.694	5.517	38.154	4.556
1910	12.738	34.123	4.446	53.486	5.370	1931	8.116	24.467	4.243	28.700	3.640
1911	12.376	42.281	4.420	53.340	5.608	1932	5.555	22.017	3.180	27.892	2.876
1912	16.341	46.096	4.471	60.835	6.799	1933	7.025	39.110	3.869	34.727	4.029
1913	15.269	44.252	4.370	59.791	5.504	1934	8.428	52.191	3.860	47.973 (e)	4.158
1914	13.602	34.301 (c)	3.862	54.811	5.061	1935	8.649	50.420	4.065	64.273 (e)	4.328
1915	17.275	38.590	4.673	49.684	13.054	1936	9.474	46.441	4.710	45.087 (e)	4.901
1916	27.202	43.480	6.858	65.661	12.634	1937	13.167	54.337	6.009	44.883 (e)	6.519
1917	27.180	61.802	8.787	81.417	8.813	1938	10.000	42.301	4.739	43.225 (e)	4.610
1918	24.628	88.750	7.413	96.772	7.890	1939	10.965	50.323	5.053	39.082 (e)	5.110

(a) Lake copper 1898; domestic copper only since 1932. (b) 99 per cent tin, 1898 to 1920, inclusive; Straits tin thereafter. (c) Average for eleven months. (d) New York zinc 1898 to 1902, inclusive. (e) Other than newly mined domestic.

Prices are in cents per pound, except those for silver, which are in cents per troy ounce.

GOLD

ing money, the Treasury returned to its former practice.

The objections to the Treasury's experiment were based on a misconception. The real cost of gold to the nation is measured in terms of what the country gives in exchange for it. In acquiring $9,000,000,000 of foreign gold from January, 1934, to August, 1939, the United States delivered to foreigners goods valued at $2,600,000,000 in excess of imports of foreign merchandise; it also permitted foreigners to acquire bank deposits and other liquid assets in this country amounting to $2,500,000,000, to buy American securities costing $1,200,000,000, and to retire indebtedness to Americans totaling $1,700,000,000. These transactions account for $8,000,000,000 of gold acquisitions, and the remaining $1,000,000,000 represents the net balance of a variety of other transactions, some of which are not identifiable.

It is perhaps questionable whether the exchange of bank deposits, American securities, and foreign debts for gold represented a bad bargain for the United States. In each case it was a matter of choice between one financial asset and another.

But the exchange of goods for gold is another proposition. The products which we send abroad are useful in themselves, but gold is not itself useful. It is true that the production of goods for export gives employment to American workmen. These workmen are employed, however, through the expenditure of money which the Government gives foreigners in exchange for gold. Instead of thus employing them, in effect, to produce goods for export, the Government could equally well employ an equivalent number of workmen directly to produce roads, dams, houses—even food and clothing for distribution to the needy. For the same amount of money paid to Americans rather than foreigners, and hence with no greater inflationary effect, the Government could obtain goods instead of gold. These goods would, for the most part, contribute immediately and directly to the general welfare. Gold, on the other hand, represents only an uncertain future claim on foreign goods and services.

There are two reasons for uncertainty concerning the future value of the United States gold hoard. One is that foreign countries, after abandoning the use of gold as money, may cease to accept it as a medium of international exchange. There are serious difficulties in the way of such a development, but they are not insuperable. Steps have already been taken in this direction. There are, for example, the various bilateral clearing arrangements under which importers of specified goods make payment in their own currencies into special accounts. The resulting balances in these accounts are then set off against each other at a rate of exchange agreed upon in advance. Much broader in scope, and hence more important, is the arrangement recently concluded by France and England whereby the use of gold between the countries is entirely eliminated for the duration of the war and six months thereafter. Settlement of any net balance due by one of these countries to the other will be effected in the currency of the debtor, not in gold. Though this is only a rational extension of the World War practice of inter-allied governmental loans, it is none the less an important move towards development of a new system of international settlements.

The second reason for uncertainty concerning the future value of the United States gold stock is that even if gold does not pass out of use as international currency there is great question whether the United States will be able to cash in on its holdings. For the past half dozen years, as already noted, foreign countries have been either unable or unwilling to give up goods or capital assets for gold. On the contrary, they have liquidated some of their gold reserves and there is every reason to believe that owing to their need for foreign goods, they will continue to do so throughout the war and post-war reconstruction periods. It is difficult, in fact, to foresee conditions which will tend to a reversal of the present one-way gold movement. Eventual recognition of this fact and its implications is bound to have a profound effect on the attitude towards gold in the United States and on the future position of the gold industry.

E & M J METAL PRICES FOR 1939 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JANUARY

Jan.	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
2	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
3	11.025	10.100	46.400	4.85	42.750	4.50
4	11.025	10.100	46.550	4.85	42.750	4.50
5	11.025	10.150	46.500	4.85	42.750	4.50
6	11.025	10.125	46.750	4.85	42.750	4.50
7	11.025	10.150	46.750	4.85	.....	4.50
9	11.025	10.150	46.675	4.85	42.750	4.50
10	11.025	9.975	46.750	4.85	42.750	4.50
11	11.025	9.950	46.700	4.85	42.750	4.50
12	11.025	9.825	46.675	4.85	42.750	4.50
13	11.025	9.850	46.600	4.85	42.750	4.50
14	11.025	9.850	46.600	4.85	.....	4.50
16	11.025	9.875	46.500	4.85	42.750	4.50
17	11.025	9.850	46.500	4.85	42.750	4.50
18	11.025	9.875	46.700	4.85	42.750	4.50
19	11.025	9.900	46.600	4.85	42.750	4.50
20	11.025	9.925	46.550	4.85	42.750	4.50
21	11.025	9.900	46.500	4.85	.....	4.50
23	11.025	9.825	46.200	4.85	42.750	4.50
24	11.025	9.825	46.250	4.75	42.750	4.50
25	11.025	9.775	46.000	4.75	42.750	4.50
26	11.025	9.775	45.200	4.75	42.750	4.50
27	11.025	9.725	45.900	4.75	42.750	4.50
28	11.025	9.725	45.900	4.75	.....	4.50
30	11.025	9.750	45.950	4.75	42.750	4.50
31	11.025	9.850	46.400	4.85	42.750	4.50
High	**11.025**	**10.150**	**46.750**	**4.850**	**42.750**	**4.500**
Low	**11.025**	**9.725**	**45.200**	**4.750**	**42.750**	**4.500**
Average	**11.025**	**9.912**	**46.404**	**4.826**	**42.750**	**4.500**

FEBRUARY

Feb.	Copper Domestic	Copper Export	Tin,	Lead	Silver	Zinc
1	11.025	9.925	46.375	4.85	42.750	4.50
2	11.025	9.875	46.100	4.85	42.750	4.50
3	11.025	9.850	45.950	4.85	42.750	4.50
4	11.025	9.875	45.950	4.85	.....	4.50
6	11.025	9.900	46.000	4.85	42.750	4.50
7	11.025	9.925	45.750	4.85	42.750	4.50
8	11.025	9.825	45.650	4.85	42.750	4.50
9	11.025	9.875	45.650	4.85	42.750	4.50
10	11.025	9.750	45.550	4.85	42.750	4.50
11	11.025	9.750	45.500	4.85	.....	4.50
13	Holiday	9.750	Holiday	Holiday	Holiday	Holiday
14	11.025	9.700	45.350	4.85	42.750	4.50
15	11.025	9.625	45.000	4.85	42.750	4.50
16	11.025	9.600	45.100	4.75	42.750	4.50
17	11.025	9.575	45.400	4.75	42.750	4.50
18	11.025	9.675	45.500	4.75	.....	4.50
20	11.025	9.675	45.400	4.75	42.750	4.50
21	11.025	9.650	45.400	4.75	42.750	4.50
22	Holiday	9.675	Holiday	Holiday	Holiday	Holiday
23	11.025	9.625	45.450	4.75	42.750	4.50
24	11.025	9.600	45.600	4.75	42.750	4.50
25	11.025	9.625	45.700	4.75	.....	4.50
27	11.025	9.650	45.700	4.75	42.750	4.50
28	11.025	9.725	46.000	4.75	42.750	4.50
High	**11.025**	**9.925**	**46.375**	**4.850**	**42.750**	**4.500**
Low	**11.025**	**9.575**	**45.000**	**4.750**	**42.750**	**4.500**
Average	**11.025**	**9.735**	**45.640**	**4.805**	**42.750**	**4.500**

MARCH

Mar.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.025	9.725	46.000	4.75	42.750	4.50
2	11.025	9.725	45.750	4.75	42.750	4.50
3	11.025	9.725	46.000	4.75	42.750	4.50
4	11.025	9.725	46.000	4.75	.....	4.50
6	11.025	9.775	46.000	4.75	42.750	4.50
7	11.025	9.800	46.000	4.75	42.750	4.50
8	11.025	9.850	46.200	4.75	42.750	4.50
9	11.025	9.950	46.350	4.85	42.750	4.50
10	11.025	9.975	46.400	4.85	42.750	4.50
11	11.025	9.975	46.375	4.85	.....	4.50
13	11.025	9.925	46.000	4.85	42.750	4.50
14	11.025	9.925	46.100	4.85	42.750	4.50
15	11.025	9.925	46.250	4.85	42.750	4.50
16	11.025	9.875	46.100	4.85	42.750	4.50
17	11.025	9.850	45.875	4.85	42.750	4.50
18	11.025	9.875	45.900	4.85	.....	4.50
20	11.025	9.875	46.000	4.85	42.750	4.50
21	11.025	9.900	46.125	4.85	42.750	4.50
22	11.025	9.925	45.950	4.85	42.750	4.50
23	11.025	9.925	46.250	4.85	42.750	4.50
24	11.025	9.950	46.625	4.85	42.750	4.50
25	11.025	9.950	46.700	4.85	.....	4.50
27	11.025	9.975	46.700	4.85	42.750	4.50
28	11.025	9.975	46.500	4.85	42.750	4.50
29	11.025	9.950	46.600	4.85	42.750	4.50
30	11.025	9.975	46.500	4.85	42.750	4.50
31	11.025	9.975	46.500	4.85	42.750	4.50
High	**11.025**	**9.975**	**46.700**	**4.850**	**42.750**	**4.500**
Low	**11.025**	**9.725**	**45.750**	**4.750**	**42.750**	**4.500**
Average	**11.025**	**9.888**	**46.213**	**4.824**	**42.750**	**4.500**

APRIL

April	Copper Electrolytic Domestic	Copper Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	11.025	9.975	46.250	4.85	.....	4.50
3	10.525 @ 11.025	9.975	46.500	4.85	42.750	4.50
4	10.525	9.925	46.100	4.85	42.750	4.50
5	10.525	9.850	46.200	4.85	42.750	4.50
6	10.525	9.850	46.150	4.85	42.750	4.50
7	10.525	9.850	46.200	4.85	42.750	4.50
8	10.525	9.825	46.200	4.85	.....	4.50
10	10.525	9.825	46.200	4.85	42.750	4.50
11	10.525	9.800	46.150	4.75	42.750	4.50
12	10.275	9.800	46.250	4.75	42.750	4.50
13	10.275	9.775	46.250	4.75	42.750	4.50
14	10.275	9.775	46.700	4.75	42.750	4.50
15	10.275	9.775	46.750	4.75	.....	4.50
17	10.275	9.775	46.875	4.75	42.750	4.50
18	10.275	9.800	47.500	4.75	42.750	4.50
19	10.275	9.775	47.500	4.75	42.750	4.50
20	10.025	9.800	47.500	4.75	42.750	4.50
21	9.775	9.775	47.850	4.75	42.750	4.50
22	9.775	9.775	48.000	4.75	.....	4.50
24	9.775	9.725	48.175	4.75	42.750	4.50
25	9.775	9.725	48.250	4.75	42.750	4.50
26	10.025	9.750	48.500	4.75	42.750	4.50
27	10.025	9.850	48.700	4.75	42.750	4.50
28	10.025	9.875	49.000	4.75	42.750	4.50
29	10.025	9.875	49.250	4.75	.....	4.50
High	**11.025**	**9.975**	**49.250**	**4.850**	**42.750**	**4.500**
Low	**9.775**	**9.725**	**46.100**	**4.750**	**42.750**	**4.500**
Average	**10.265**	**9.820**	**47.160**	**4.782**	**42.750**	**4.500**

MAY

May	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	10.025	9.825	49.250	4.75	42.750	4.50
2	10.025	9.775	49.250	4.75	42.750	4.50
3	10.025	9.775	49.350	4.75	42.750	4.50
4	10.025	9.800	49.250	4.75	42.750	4.50
5	10.025	9.800	49.250	4.75	42.750	4.50
6	10.025	9.800	49.250	4.75	.....	4.50
8	9.775	9.825	49.125	4.75	42.750	4.50
9	9.775	9.750	49.150	4.75	42.750	4.50
10	9.775	9.775	49.300	4.75	42.750	4.50
11	9.775	9.825	49.250	4.75	42.750	4.50
12	9.775	9.800	49.000	4.75	42.750	4.50
13	9.775	9.775	48.875	4.75	.....	4.50
15	9.775	9.750	48.875	4.75	42.750	4.50
16	9.775	9.750	48.875	4.75	42.750	4.50
17	9.775	9.675	49.000	4.75	42.750	4.50
18	9.775	9.625	48.850	4.75	42.750	4.50
19	9.775	9.625	48.850	4.75	42.750	4.50
20	9.775	9.625	48.850	4.75	.....	4.50
22	9.775	9.625	48.800	4.75	42.750	4.50
23	9.775	9.625	48.700	4.75	42.750	4.50
24	9.775	9.625	48.800	4.75	42.750	4.50
25	9.775	9.650	48.900	4.75	42.750	4.50
26	9.775	9.725	49.000	4.75	42.750	4.50
27	9.775	9.725	49.000	4.75	.....	4.50
29	9.775	9.725	49.000	4.75	42.750	4.50
30	Holiday	9.800	Holiday	Holiday	Holiday	Holiday
31	9.775	9.850	49.000	4.75	42.750	4.50
High	**10.025**	**9.850**	**49.350**	**4.750**	**42.750**	**4.500**
Low	**9.775**	**9.625**	**48.700**	**4.750**	**42.750**	**4.500**
Average	**9.833**	**9.738**	**49.031**	**4.750**	**42.750**	**4.500**

JUNE

June	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	9.775	9.825	49.000	4.75	42.750	4.50
2	9.775	9.825	49.000	4.75	42.750	4.50
3	9.775	9.825	49.000	4.75	.....	4.50
5	9.775	9.850	48.900	4.75	42.750	4.50
6	9.775	9.825	48.750	4.75	42.750	4.50
7	9.775	9.825	48.750	4.75	42.750	4.50
8	9.775	9.800	48.700	4.75	42.750	4.50
9	9.775	9.775	48.500	4.75	42.750	4.50
10	9.775	9.775	48.500	4.75	.....	4.50
12	9.775	9.750	48.300	4.75	42.750	4.50
13	9.775	9.650	48.400	4.75	42.750	4.50
14	9.775	9.675	48.700	4.80	42.750	4.50
15	9.775	9.675	48.725	4.80	42.750	4.50
16	9.775	9.675	48.725	4.80	42.750	4.50
17	9.775	9.675	48.750	4.80	.....	4.50
19	9.775	9.675	49.000	4.85	42.750	4.50
20	9.775	9.700	49.100	4.85	42.750	4.50
21	9.775	9.725	49.125	4.85	42.750	4.50
22	9.775	9.725	49.100	4.85	42.750	4.50
23	9.775	9.675	49.100	4.85	42.750	4.50
24	9.775	9.700	49.100	4.85	.....	4.50
26	9.775	9.700	49.000	4.85	42.750	4.50
27	9.775	9.700	49.000	4.85	39.750	4.50
28	9.775	9.700	48.950	4.85	38.250	4.50
29	9.775	9.700	49.000	4.85	37.750	4.50
30	9.775	9.775	49.000	4.85	37.750	4.50
High	**9.775**	**9.850**	**49.125**	**4.850**	**42.750**	**4.500**
Low	**9.775**	**9.650**	**48.300**	**4.750**	**37.750**	**4.500**
Average	**9.775**	**9.738**	**48.853**	**4.800**	**41.955**	**4.500**

E & M J METAL PRICES FOR 1939 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JULY

July	Copper Electrolytic Domestic	Copper Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	9.775	9.825	48.900	4.85	.....	4.50
3	9.775	9.850	48.750	4.85	.....	4.50
4	Holiday	9.875	Holiday	Holiday	Holiday	Holiday
5	9.775	9.900	48.600	4.85	.....	4.50
6	9.775	9.900	48.600	4.85	36.500	4.50
7	9.790	9.950	48.650	4.85	36.500	4.50
8	10.025	9.975	48.650	4.85	.....	4.50
10	10.025	10.025	48.500	4.85	34.750	4.50
11	10.025	10.025	48.450	4.85	34.750	4.50
12	10.025	9.950	48.500	4.85	34.750	4.50
13	10.025	9.900	48.575	4.85	34.750	4.50
14	10.025	9.925	48.600	4.85	34.750	4.50
15	10.025	9.925	48.600	4.85	.....	4.50
17	10.025	9.950	48.600	4.85	34.750	4.50
18	10.025	9.950	48.600	4.85	34.750	4.50
19	10.025	9.975	48.525	4.85	34.750	4.50
20	10.025	9.925	48.500	4.85	34.750	4.50
21	10.025	9.950	48.500	4.85	34.750	4.50
22	10.025	9.950	48.500	4.85	.....	4.50
24	10.025	9.950	48.450	4.85	34.750	4.50
25	10.025	9.950	48.450	4.85	34.750	4.50
26	10.025	9.950	48.400	4.85	34.750	4.50
27	10.025	9.975	48.450	4.85	34.750	4.60
28	10.025	9.975	48.450	4.85	34.750	4.60
29	10.025	10.000	48.450	4.85	.....	4.60
31	10.025	10.025	48.450	4.95	34.750	4.60
High	**10.025**	**10.025**	**48.900**	**4.950**	**36.500**	**4.600**
Low	**9.775**	**9.825**	**48.400**	**4.850**	**34.750**	**4.500**
Average	**9.976**	**9.944**	**48.548**	**4.854**	**34.944**	**4.516**

AUGUST

Aug.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	10.150	10.050	48.450	4.95	34.750	4.60
2	10.150	10.125	48.500	4.95	34.750	4.60
3	10.150	10.200	48.650	5.05	34.750	4.60
4	10.275	10.300	48.850	5.05	34.750	4.60
5	10.275	10.300	48.850	5.05	.....	4.60
7	10.275	10.325	48.800	5.05	34.750	4.675
8	10.275	10.325	48.700	5.05	34.750	4.75
9	10.275	10.275	48.700	5.05	34.750	4.75
10	10.275	10.200	48.725	5.05	35.125	4.75
11	10.275	10.200	48.700	5.05	35.250	4.75
12	10.275	10.175	48.700	5.05	.....	4.75
14	10.275	10.200	48.750	5.05	35.625	4.75
15	10.275	10.200	48.750	5.05	35.750	4.75
16	10.275	10.175	48.750	5.05	35.250	4.75
17	10.275	10.125	48.750	5.05	35.250	4.75
18	10.275	10.225	48.825	5.05	35.375	4.75
19	10.275	10.275	48.800	5.05	.....	4.75
21	10.275	10.225	48.700	5.05	36.500	4.75
22	10.275	10.225	48.700	5.05	37.750	4.75
23	10.275	10.200	49.000	5.05	37.250	4.75
24	10.275	10.150	49.500	5.05	39.625	4.75
25	10.275	10.150	48.875	5.05	39.750	4.75
26	10.275	10.125	49.000	5.05	.....	4.75
28	10.275	10.150	48.125	5.05	36.125	4.75
29	10.275	10.250	49.125	5.05	37.000	4.75
30	10.275	10.300	48.875	5.05	36.500	4.75
31	10.275	10.250	49.250	5.05	35.500	4.75
High	**10.275**	**10.325**	**49.500**	**5.050**	**39.750**	**4.750**
Low	**10.150**	**10.050**	**48.125**	**4.950**	**34.750**	**4.600**
Average	**10.261**	**10.211**	**48.793**	**5.043**	**35.951**	**4.719**

SEPTEMBER

Sept.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	10.275	10.175	50.500	5.05	35.500	4.75
2	10.775	11.000	52.000	5.05	.....	5.00
4	Holiday	11.000	Holiday	Holiday	Holiday	Holiday
5	10.775	11.425	60.000	5.25	35.500	5.65
6	11.775	11.700	60.000	5.375	36.250	5.95
7	11.775	11.800	62.500	5.50	36.750	6.00
8	11.775	11.800	64.750	5.50	36.750	6.00
9	11.775	11.800	66.000	5.50	.....	6.00
11	11.775	11.900	70.000	5.50	36.125	6.125
12	11.775	11.925	70.000	5.50	36.000	6.25
13	11.775	11.875	74.500	5.50	36.375	6.25
14	11.775	11.875	72.000	5.50	36.000	6.25
15	11.775	11.750	68.000	5.50	36.250	6.25
16	11.775	12.000	68.000	5.50	.....	6.25
18	11.775	11.625	68.000	5.50	36.750	6.25
19	11.775	11.750	68.100	5.50	38.500	6.25
20	11.775	11.750	68.100	5.50	38.500	6.25
21	11.775	11.750	68.000	5.50	38.750	6.25
22	11.775	11.750	67.000	5.50	39.250	6.25
23	11.775	11.750	66.000	5.50	.....	6.25
25	11.775	11.750	65.000	5.50	39.250	6.25
26	11.775	11.875	64.000	5.50	39.125	6.25
27	11.775	11.875	62.250	5.50	37.250	6.375
28	11.775	11.950	60.000	5.50	35.250	6.50
29	11.775	11.950	60.000	5.50	35.000	6.50
30	11.775	12.000	60.000	5.50	.....	6.50
High	**11.775**	**12.000**	**74.500**	**5.500**	**39.250**	**6.500**
Low	**10.275**	**10.175**	**50.500**	**5.050**	**35.000**	**4.750**
Average	**11.635**	**11.685**	**64.588**	**5.449**	**36.956**	**6.104**

OCTOBER

Oct.	Copper Electrolytic Domestic	Copper Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
2	11.775	12.000	59.000	5.50	34.875	6.50
3	11.775	12.125	59.000	5.50	35.125	6.50
4	11.775	12.250	55.250	5.50	35.000	6.50
5	12.275	12.300	55.000	5.50	35.000	6.50
6	12.275	12.400	55.000	5.50	35.125	6.50
7	12.275	12.400	55.000	5.50	.....	6.50
9	12.275	12.450	55.000	5.50	36.250	6.50
10	12.275	12.450	55.000	5.50	36.250	6.50
11	12.275	12.450	55.000	5.50	36.375	6.50
12	Holiday	12.450	Holiday	Holiday	Holiday	Holiday
13	12.275	12.450	55.000	5.50	37.500	6.50
14	12.275	12.450	55.000	5.50	.....	6.50
16	12.275	12.450	55.000	5.50	37.000	6.50
17	12.275	12.450	55.000	5.50	36.000	6.50
18	12.275	12.450	55.000	5.50	36.000	6.50
19	12.275	12.450	55.500	5.50	35.750	6.50
20	12.275	12.500	55.500	5.50	35.750	6.50
21	12.275	12.700	55.500	5.50	.....	6.50
23	12.275	12.700	55.500	5.50	36.125	6.50
24	12.275	12.700	55.750	5.50	36.500	6.50
25	12.275	12.700	55.750	5.50	36.250	6.50
26	12.275	12.700	55.750	5.50	35.000	6.50
27	12.275	12.700	55.750	5.50	34.875	6.50
28	12.275	12.700	55.750	5.50	.....	6.50
30	12.275	12.700	55.500	5.50	34.750	6.50
31	12.275	12.700	55.000	5.50	34.750	6.50
High	**12,275**	**12.700**	**59.000**	**5.500**	**37.500**	**6.500**
Low	**11.775**	**12.000**	**55.000**	**5.500**	**34.750**	**6.500**
Average	**12.215**	**12.491**	**55.580**	**5.560**	**35.776**	**6.500**

NOVEMBER

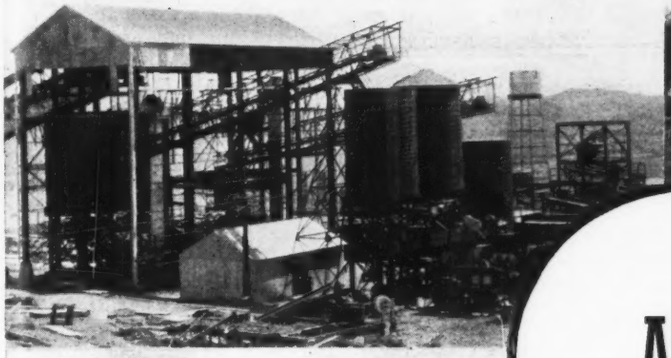
Nov.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	12.275	12.700	54.000	5.50	34.750	6.50
2	12.275	12.700	53.575	5.50	34.750	6.50
3	12.275	12.950	53.000	5.50	34.750	6.50
4	12.275	12.950	52.250	5.50	.....	6.50
6	12.275	12.950	52.250	5.50	34.750	6.50
7	Holiday	12.950	Holiday	Holiday	Holiday	Holiday
8	12.275	12.950	51.000	5.50	34.750	6.50
9	12.275	12.950	50.000	5.50	34.750	6.50
10	12.275	12.950	50.000	5.50	34.750	6.50
11	Holiday	12.950	Holiday	Holiday	.....	Holiday
13	12.275	12.950	51.000	5.50	34.750	6.50
14	12.275	12.950	51.000	5.50	34.750	6.50
15	12.275	12.950	51.000	5.50	34.750	6.50
16	12.275	12.950	51.000	5.50	34.750	6.50
17	12.275	12.950	51.500	5.50	34.750	6.50
18	12.275	12.950	51.500	5.50	.....	6.50
20	12.275	12.900	51.575	5.50	34.750	6.50
21	12.275	12.950	52.500	5.50	34.750	6.50
22	12.275	12.950	53.000	5.50	34.750	6.50
23	Holiday	12.950	Holiday	Holiday	Holiday	Holiday
24	12.275	12.950	53.500	5.50	34.750	6.50
25	12.275	12.950	53.750	5.50	.....	6.50
27	12.275	12.950	54.500	5.50	34.750	6.50
28	12.275	12.950	54.000	5.50	34.750	6.50
29	12.275	12.950	54.000	5.50	34.750	6.50
30	12.275	12.950	53.500	5.50	34.750	6.50
High	**12.275**	**12.950**	**54.500**	**5.500**	**34.750**	**6.500**
Low	**12.275**	**12.700**	**50.000**	**5.500**	**34.750**	**6.500**
Average	**12.275**	**12.929**	**52.322**	**5.500**	**34.750**	**6.500**

DECEMBER

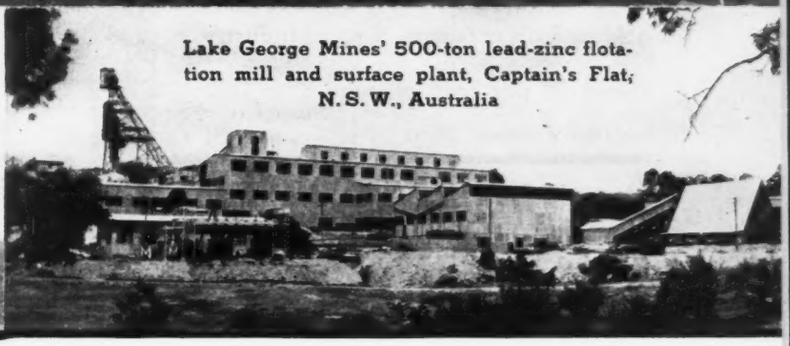
Dec.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	12.275	12.900	52.375	5.50	34.750	6.00
2	12.275	12.925	52.375	5.50	.....	6.00
4	12.275	12.900	52.125	5.50	34.750	6.00
5	12.275	12.900	52.000	5.50	34.750	6.00
6	12.275	12.900	51.750	5.50	34.750	6.00
7	12.275	12.800	51.250	5.50	34.750	6.00
8	12.275	12.800	51.125	5.50	34.750	6.00
9	12.275	12.700	51.000	5.50	.....	6.00
11	12.275	12.700	51.125	5.50	34.750	6.00
12	12.275	12.700	51.250	5.50	34.750	6.00
13	12.275	12.700	51.000	5.50	34.750	6.00
14	12.275	12.600	50.500	5.50	34.750	6.00
15	12.275	12.550	50.500	5.50	34.750	6.00
16	12.275	12.550	50.500	5.50	.....	6.00
18	12.275	12.575	50.250	5.50	34.750	6.00
19	12.275	12.550	50.375	5.50	35.125	6.00
20	12.275	12.525	50.500	5.50	36.125	6.00
21	12.275	12.525	49.750	5.50	36.500	6.00
22	12.275	12.450	50.250	5.50	35.375	6.00
23	12.275	12.450	50.250	5.50	.....	6.00
26	12.275	12.450	49.875	5.50	34.750	6.00
27	12.275	12.425	50.000	5.50	34.750	6.00
28	12.275	12.400	49.375	5.50	34.750	6.00
29	12.275	12.400	49.500	5.50	34.750	5.75
30	12.275	12.400	49.500	5.50	.....	5.75
High	**12.275**	**12.925**	**52.375**	**5.500**	**36.500**	**6.000**
Low	**12.275**	**12.400**	**49.375**	**5.500**	**34.750**	**5.750**
Average	**12.275**	**12.631**	**49.500**	**5.500**	**34.956**	**5.980**

Yuba 20, the world's largest gold dredge, near Hammonton, Calif.

Saudi Arabian Mining Syndicate's 300-ton flotation plant, in the Hedjaz, Saudi Arabia

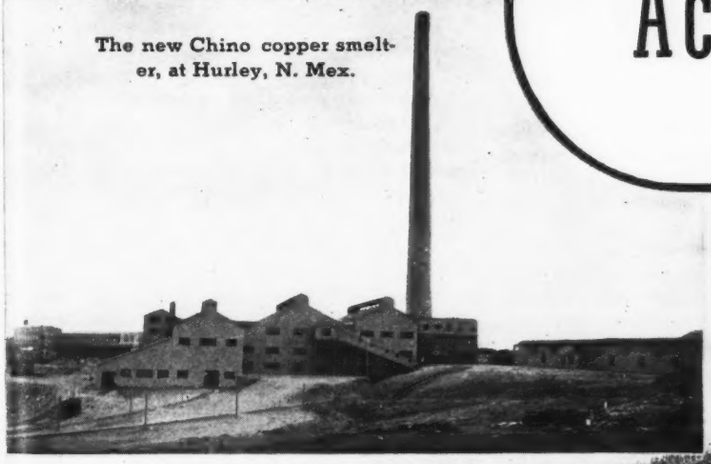


Lake George Mines' 500-ton lead-zinc flotation mill and surface plant, Captain's Flat, N. S. W., Australia

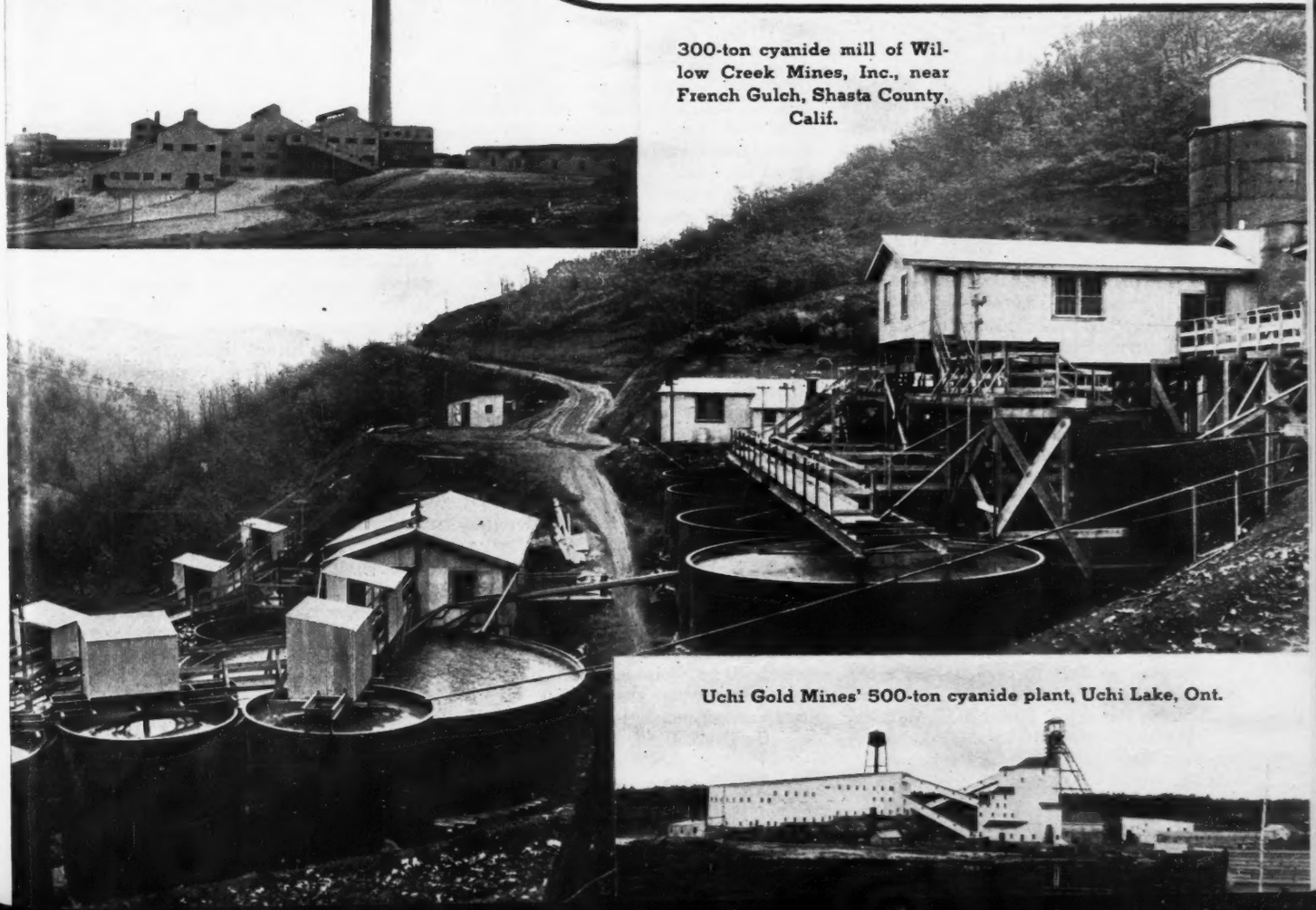


Activities of the Year

The new Chino copper smelter, at Hurley, N. Mex.



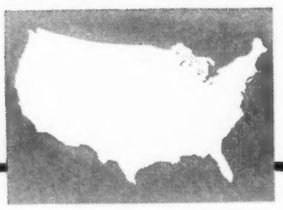
300-ton cyanide mill of Willow Creek Mines, Inc., near French Gulch, Shasta County, Calif.



Uchi Gold Mines' 500-ton cyanide plant, Uchi Lake, Ont.

UNITED STATES

Higher production of copper, lead and zinc ores accounts for principal gain in gold and silver output. Copper industry shows 30 per cent increase over 1938



H. C. CHELLSON
Assistant Editor

MINING in the United States in 1939 followed the pattern of activity similar to that of 1938, with the exception that intensity was considerably greater in the last four months of 1939, resulting from increased industrial activity and the excitement created by the outbreak of war in Europe. Substantial increases in precious- and base-metal output followed, but production, with the exception of gold, did not reach that obtained in 1937.

In the first quarter of 1939 curtailment of copper output occurred and metal prices eased. Political developments in Europe in early April provoked unsettlement in all industry, and metal prices moved lower. In early summer, production and consumption of metals were fairly well in balance. Buying of large quantities of domestic copper by France in July in the face of low copper inventories held by consumers here, quickly brought the copper industry to life, and production schedules increased. A higher price set for domestic silver during this period also stimulated the industry. Early in September, when England and France announced war against Germany, metal prices increased and buying of copper assumed frenzied proportions. Employment and wages at the mines gained and the industry rode along on this surge of activity into 1940.

A brief summary of leading and interesting events in the domestic industry for the 1939 record, and reports from the principal mining states, with statistics of the Bureau of Mines, follows: *Silver price*—Miners obtained 64.64c. per ounce until Congress approved on July 6, 1939, an act establishing the quotation of 71.1c. per ounce for newly mined domestic silver produced on July 2 and thereafter. *Assessment work*—This was resumed on July 1, 1939, after being suspended by Congress since July 1, 1933. Idle mining claims will at last receive some development. *Wages and Hours Act*—A full year of experience with this law brought on much discussion and explaining on the new wages and hours among employers, miners, and their families; operating schedules at many mines became unsettled, and in numerous instances declines in efficiency were experienced, bringing higher operating costs; a resultant action of this law is believed by observers to encourage operators to mechanize their properties as much as conditions permit; placer mining was severely hit by the act, but late in 1939 the Wage and Hour Division made final the seasonal exemption from the maximum hours provision of the Fair Labor Standards Act for open-cut mining of placer gold in Alaska, Idaho, Montana, Nevada, Oregon, South Dakota, Utah, Washington, and Wyoming. *Lower tariff*—The tariff on foreign zinc entering this country effective Jan. 1, 1939, made continued operations at many zinc properties uncertain. Late in 1939 many mines suspended operations as foreign metal was attracted to this country by the higher price for zinc. Wages and employment have dropped at many zinc mines as a consequence. *Employment*—A better-than-seasonal pick-up occurred at base-metal mines in the last four months of the year. Wages and labor contracts based on the sliding scale of metal prices were the acceptable basis for settlement of wage disputes between miners and operators; most labor strikes at mines and smelters were of short duration during the year; using 100 as the 1929 basis of employment in the industry, the Bureau of Labor Statistics, reported the November index at 66.5, against 59.4 for the same month in 1938. *Interesting events*—Of interest in the 1939 record were the extensive preparation of the large Clay copper orebody in Morenci, Ariz., by the Phelps Dodge Corporation, and completion of preliminary work for erection of its new smelter and a 25,000-ton concentrator; the completion of a new copper smelter at Hurley, N. M., by the Nevada Consolidated Copper Corporation; the start of construction by Bunker Hill & Sullivan of a plant to smelt concentrates from the high bismuth content tetrahedrite ores in the Coeur d'Alenes, in Idaho; revival of tin smelting in this country by the Phelps Dodge Refining Corporation and American Metal Company was announced. Experiments are under way for refining tin concentrates, employing a new process. On July 13, 1939, a new drainage tunnel, to be six miles long, was started in Cripple Creek district, Colo. *Ore exhaustion*—Exhaustion of ores occurred at the Pecos mine, in New Mexico, forcing closing of this silver-lead-zinc-copper producer after twelve years and five months' operation; liquidation of the United Verde Extension Mining Company of Arizona finally occurred in December, after prospecting for several years failed to determine any worth-while copper ore extensions; Alaska's copper output declined sharply because the Kennecott property was completely shut down late in 1938 and all equipment sold; in Michigan, the Conglomerate lode, once a large producer of native copper, was reported virtually exhausted late in 1939.

The year's activity in the leading mining states indicates the capacity of some properties in this country to produce metal. Since mining and metallurgical engineers have improved their technique, lower-grade ore deposits can be brought into production if and when the time arrives for their profitable exploitation.

ARIZONA — Production from Arizona's diversified mineral deposits increased in 1939. Most of the activity, however, occurred among the large copper mines during the last quarter. Gold, silver, copper, lead, and zinc output was valued at $72,433,400 in 1939, against $58,358,401 in 1938, with almost 90 per cent of the increased value being in copper.

Gold output from lode mines was about 316,500 oz. and placers accounted for approximately 6,500 oz., both being an increase above 1938 production. About two-thirds of the gold produced from placers was recovered by a dragline unit on Lynx Creek, in Yavapai County, and by operations at the Arizona drift mine near Quartzite, Yuma County. Copper mines were among the principal gold producers, being the Copper

Queen, United Verde, and New Cornelia. These three mines, together with the Mammoth-St. Anthony and Gold Road properties, produced 55 per cent of the State's gold output.

Silver production increased from 7,479,153 oz. in 1938 to about 7,975,540 oz. in 1939, with almost half of this output coming from the Copper Queen and United Verde copper mines of the Phelps Dodge Corporation. Other mines contributing to this output were the Magma, Eagle Picher, Ash Peak, Denn, Iron King, Reymert, Trench, New Cornelia, Golden Turkey, Arizona Magma, and Alpha-Keystone.

Nine mines accounted for the production of 513,800,000 lb. of copper, or 99 per cent of the State's total of 518,400,000 lb. The largest producer was the New Cornelia mine, at Ajo, followed by Copper Queen, United Verde, Miami and Denn properties. Based on districts, the greatest production came from Globe, where the Inspiration and Miami mines are located; next was the Warren district, followed by Ajo. Continuation of the large development and construction program at the Morenci property of the Phelps Dodge Corporation held the interest of the copper industry. Production from Morenci during the year consisted of cement copper from underground leaching operations and copper concentrates from the 1,500-ton pilot plant started early in 1939.

Lead production increased slightly, due chiefly to the Trench zinc-lead mine of the American Smelting & Refining Company, that started operation during 1939. The largest lead producer, however, was the Montana mine, at Ruby, operated by the Eagle-Picher Mining & Smelting Company, followed by the Trench, Mammoth-St. Anthony, Hillside, and Tennessee-Schuylkill.

Zinc output came from six properties, which accounted for virtually all of the 6,850 tons produced during the year. Leading producers were the Montana, at Ruby; Magma, at Superior; and Trench mine, near Patagonia. The Magma mine doubled its 1938 production of zinc, due to increased output of zinc-copper ore.

CALIFORNIA — Reopening of old mines and expanded operations at many properties, plus a greater number of placer gold operations, and more dragline-dredge units, accounted for a 7 per cent increase in California's gold output in 1939, which totaled 1,406,100 oz., against 1,311,129 oz. in 1938. Some lode mines gained prominence by finding new ore. The major producing company in 1939 was the Idaho Maryland Mines Corporation, operating the Idaho Maryland and Brunswick properties, in the Grass Valley-Nevada City district, followed by the Empire Star Mines Company, Ltd., which was the leading producer in 1938. Others were the Lava Cap Gold Mining Corporation and the Golden Center mine, both operating in the Grass Valley-Nevada City district. A mine opened years ago and now operated by the Alhambra-Shumway Mine, Inc., in Eldorado County, revealed some unusually rich ore, which many consider the outstanding gold strike in the State during the year. The Central Eureka Mining Company, in Amador County, expanded its operations, and greater output was reported by the Argonaut and Kennedy mines. Results of a serious underground fire in 1938 at the Argonaut were overcome in 1939 when operations reached a more normal basis. Development on the 5,500-ft. level of the Kennedy mine revealed possibilities of a substantial tonnage of new ore. Treating a large tonnage of low-grade gold on the Mother Lode, in Calaveras County, the Carson Hill Gold Mining Corporation, at Melones, was the leading producer. In the East Belt district, the St. Joseph Lead Company's property, the Sheepranch mine, was the most important producer. Mines operated in Kern County by the Golden Queen Mining Company, the Cactus Mines Company, and the Lodestar Mining Company accounted for most of the gold output from the Mojave district. In Plumas County the Walker Mining Company had an active year, producing copper which accounted for a substantial increase in gold as a byproduct.

Large connected-bucket type floating dredges recovered most of the placer gold during the year, but a preliminary count by the Bureau of Mines of operating dragline dredges in 1939 passed 100, against 80 in 1938. This accounts for the approximate 50 per cent increase in gold output during the year by all the smaller dredges. Marking an advance in dredging technique, a gold dredge known as the Yuba 20 was launched in May near Hammonton that can dig 124 ft. below water line while handling a 50-ft. bank above water.

Silver production increased in 1939, output totaling 2,612,000 oz., against 2,590,804 oz. in 1938. The gain is accounted for by greater gold production where silver is a byproduct and by increased copper output at the Walker mine, Plumas County. The Grigsby mine, Palisade County, operated by the Graham Loftus Oil Corporation, is the only important property where silver is the principal metal produced.

Copper production showed a large gain in 1939, when 4,207 tons were produced, against 806 tons in 1938. Full operations at the property of the Walker Mining Company during the year accounted for virtually all of California's copper output.

COLORADO—The gross value of gold, silver, copper, lead, and zinc production in 1939 was $22,245,979, against $22,073,663 in 1938 and $22,107,207 in 1937. Higher prices for silver and base metals brought this value above that of the previous year, even though gold, copper, lead, and zinc production in the State was below that of 1938. The Bureau of Mines reports that mine employment

Principal United States Production of Gold, Silver, Copper, Lead, and Zinc

(United States Bureau of Mines)

Mine production of metals in 1938 and 1939 in terms of the recovered and recoverable metal in ounces and short tons. Figures for 1939 estimated.

	Gold, Oz.		Silver, Oz.		Copper, Tons		Lead, Tons		Zinc, Tons	
	1938	1939	1938	1939	1938	1939	1938	1939	1938	1939
Arizona	305,043	323,000	7,479,153	7,975,540	210,797	259,200	10,571	10,750	5,814	6,850
California	1,311,129	1,406,100	2,590,804	2,612,000	806	4,207	495	426	.....	6
Colorado	367,468	364,719	7,932,095	8,393,642	14,171	13,414	9,455	8,130	4,553	1,700
Idaho	103,513	114,000	18,993,676	17,199,600	2,139	2,375	92,177	90,700	44,030	46,575
Montana	203,313	255,600	6,403,962	8,898,450	77,213	98,555	9,327	16,210	8,844	34,850
Nevada	296,434	339,000	4,355,471	4,066,000	46,169	65,415	4,679	4,081	8,944	6,436
New Mexico	43,050	36,991	1,229,860	1,423,480	20,439	45,913	4,949	5,463	28,236	31,718
Oregon	81,729	91,100	100,507	101,000	38	47	23	13	.....	.....
South Dakota	594,847	608,000	162,295	168,600	.....	.....	.....	.....	.....	.....
Texas	439	355	1,433,008	1,349,709	16	20	342	230	.....	.....
Utah	200,630	276,060	9,682,732	10,574,987	108,126	170,520	65,657	65,413	33,658	33,357
Washington	74,175	89,300	380,938	442,200	6,017	8,932	4,284	3,537	11,402	9,731
Wyoming	798	600	328	75	.....	.....	.....	.....	.....	.....
Central States	.....	4	386,210	307,077	46,743	44,000	158,873	197,810	198,721	223,296
Eastern States	19,928	17,560	94,945	93,442	10,540	9,937	7,900	6,263	172,501	181,052
Alaska	664,973	681,000	479,853	209,300	14,549	165	994	919	.....	.....
Totals	4,267,469	4,603,389	61,705,837	63,815,102	557,763	722,700	369,726	409,945	516,703	575,571

was about the same as in 1938, involving an average of 7,600 men. Assessment work, effective in 1939 for the first time since 1933, increased activity slightly and the total number of producing lode mines, prospects, and dumps increased from 669 in 1938 to about 690 in 1939 and placer operations from 592 to around 650. About 52 mills having capacities ranging from 35 to 1,600 tons daily, totaling 6,925 tons, and 25 plants ranging from 5 to 30 tons, totaling 400 tons daily, were in operation all or at some time during the year. Some mills, at mines where enough ore is not available for continuous operation, were run for short periods only. The largest operation continued to be that of the Climax Molybdenum Company, at Climax, which operated its 12,000-ton mill about 70 per cent of capacity and produced concentrates containing 21,750,000 lb. of elemental molybdenum. Production from tungsten mines in Boulder County was higher in 1939. Vanadium output continued steady from the roasting and leaching plant at Uravan, Montrose County. The McIntyre district, San Miguel County, also produced some vanadium ore.

Gold production in the Cripple Creek district was lower because of a decline in average grade of the ore. Operations at the Golden Cycle mine declined because of necessary suspension of operations below the Roosevelt drainage level, so as to drive the new 9-mile Carlton drainage tunnel, which at the end of the year was in about 7,500 ft. In San Juan County, metal output declined because of the all-year shutdown of the Sunnyside mine, at Eureka. A labor strike from July 16 to Sept. 5 at the Shenandoah-Dives Mining Company mine, at Silverton, disrupted operations generally in the district, as the company operated a custom mill.

Silver production came chiefly from the Eagle mine of the Empire Zinc Division of the New Jersey Zinc Company, at Gilman. Its 600-ton underground flotation mill was idle in 1939. This mine also accounted for most of the State's copper output. Lead and zinc came chiefly from San Miguel, Eagle and Lake counties.

IDAHO—Output of silver from the leading producing State declined further in 1939. Production totaled 17,199,600 oz., against 18,993,676 oz. in 1938 and 19,587,766 oz. in 1937. The decrease is believed to be due to decreased activity among base-metal mines earlier in the year and the uncertainty of the price for newly mined domestic silver, which, however, was increased from 64c. per ounce to 71.11c. per ounce effective July 2, 1939. The Sunshine Mining Company continued as the nation's largest silver producer. Among other producers were the Bunker Hill & Sullivan, Polaris, Triumph, Morning, and Hecla.

Gold production increased from 103,513 oz. in 1938 to about 114,000 oz. in 1938. The Bureau of Mines reports that eight connected-bucket dredges recovered about 29,000 oz. and several dragline operations about 14,000 oz. Four bucket dredges in the Boise Basin district recovered more than one-third of the output of placer gold. Among the leading gold producers in the State were the Fisher & Baumhoff dredges at Centerville, the Golden Anchor mine, at Burgdorf, the Boise-Rochester property, at Atlanta, Triumph mine, near Ketcham, and Warren Dredging Company at Warren.

About half of Idaho's copper production comes as a byproduct of silver ore produced by the Sunshine Mining Company, and the remainder from lead-zinc producers. Copper output in 1939 was 2,375 tons, against 2,139 tons in 1938.

Lead production declined in 1939 to 90,700 tons, against 92,177 tons in 1938. Decreases were reported by Hecla Mining Company, Snyder Mines, Inc., and Bunker Hill & Sullivan Mining & Concentrating Company. Greater production of lead occurred at the Morning mine of the Federal Mining & Smelting Company, believed to be due to the development of a new orebody.

Zinc output increased in 1939 to 46,575 tons, against 44,030 tons in 1938. The Morning mine was the leading producer, followed by Hecla, Bunker Hill & Sullivan, Triumph Star, Hecla, Page, and Frisco mines.

MONTANA—Production of precious and base metals increased sharply in 1939 above the figures of the previous year. This was due principally to the demand for copper, lead, and zinc, which brought higher metal prices during the last quarter.

Gold output in 1939 totaled about 255,000 oz., against 203,313 oz. in 1938. Enjoying their first full operating season in 1939, the following three new connected-bucket dredges —the Winston, Perry-Schroeder, and Gold Creek dredge — accounted for most of the year's increased gold production. In November, 1939, a new Yuba gold dredge operated by the Star Pointer Exploration Company on Bear Creek started recovering gold. New installations of dragline dredges were also made during the year. The leading gold producers in the State were the West Mayflower mine of the Anaconda Copper Mining Company, the Winston dredge and dragline plants near Clancy, the Ruby Gulch, Butte Highlands, and Victoria mines, and the Porter dredge at Helena.

Silver production was 39 per cent above that for 1938. The total for the year was 8,898,450 oz., against 6,403,962 oz. in 1938. The copper and lead-zinc ores produced by Anaconda accounted for most of the increase in silver production.

Copper output increased during the year to 98,555 tons, against 77,217 tons in 1938. During most of the year operations by Anaconda were on a curtailed basis, but with the upswing in industry in the last quarter, several of its copper mining units stepped up output to near capacity.

Resumption of operations of the Orphan Girl mine early in 1939, together with other lead-zinc properties of the Anaconda Copper Mining Company later in the year, accounts for the increased output of other metals. Lead production in the State totaled 16,210 tons in 1939, against 9,327 tons in 1938. Zinc production totaled 34,850 tons, against 8,844 tons in 1938.

NEVADA—In 1939 copper regained its position as the most valuable mineral produced in the State, replacing gold, which had the highest value in output during 1938. The Bureau of Mines reports a 50 per cent increase in value of copper production and a 14 per cent increase in gold during 1939 over the records for the previous year.

Higher gold output is credited to the increased production at the Getchell mine and to operation for a full year of the new dredge by the Manhattan Gold Dredging Company and greater copper production in the Robinson district by the Nevada Consolidated Copper Corporation and Consolidated Coppermines Corporation. The first gold bullion from the Standard mine was shipped late in 1939.

Silver production declined from 4,355,471 oz. in 1938 to 4,066,000 oz. in 1939. The leading producer was the Nivloc mine, operated by Desert Silver, Inc., in the Silver Peak district. The Mizpah and Tonopah Belmont mines, at Tonopah, also were large producers of silver. Expanded operations of the two large copper properties in the Robinson district during the last quarter also contributed a substantial share of the output. The decline in silver output in 1939 is believed to have been due to the suspension of operations at some gold mines which produced silver as a byproduct and to the lower rate of operation at base-metal mines during the first eight months of the year.

Copper production advanced sharply from 46,169 tons in 1938 to 65,715 tons in 1939. The largest producer continued to be the Nevada

(*Continued on page* 119)

CANADA

Steady expansion in all mining except lead-zinc. Twenty new gold producers enter list. Dominion's base metals are conscripted for war

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THE Canadian mining industry established all-time records in 1939 for gold, copper, and nickel. Ontario is once more a producer of iron ore, and metal mining, in general, although conscripted for war purposes, is in a sound position and operating at capacity, except for lead and zinc. The total value of mineral production is estimated at $470,000,000, up 8 per cent from the 1938 figures and exceeding the record figure for 1937 ($457,359,092).

Gold mining in 1939 added twenty new producers, two of them being reorganizations of former operators. Combined capacity of these mills amounts to 4,935 tons. Twelve producing mines increased mill capacity by a total of 2,815 tons. Lake Shore reduced production by 10 per cent as a result of operating problems. The year 1938 marked first production for 39 gold mines, the extent of falling off in new enterprise being the direct result of curtailed prospecting, which in turn was due to poor conditions for speculative financing.

Gold output for the year exceeded 5,000,000 oz. for the first time, with an estimated value of $181,274,189, compared with $164,561,000 in 1938 and $143,326,493 in 1937. There are prospects of a further increase of half a million ounces in 1940. The war was indirectly the cause of higher prices for Canadian gold. Early in September exchange dropped 10 per cent to a point about midway between the United States dollar and British sterling. Although the price of $38.50 per ounce remained stable in the last quarter of the year, there are indications that exchange adjustments in the near future will scale the price upward. This factor may be expected to stimulate the search for new mines in 1940 and to some extent offset the reduced activity of the last three years.

The value of all non-metallic minerals produced in 1939 was $95,184,000 of which coal, gas, and petroleum accounted for $70,757,000, compared with $88,324,150 in 1937 and $87,465,000 in 1938. Asbestos output from the Thetford district of Quebec, amounting to 57 per cent of world tonnage, increased in valuation to $14,603,000.

Table I lists 18 mining companies whose plans call for mill construction in 1940. In Table II are listed 141 gold producers and 18 base-metal mines that are operating at present. The record also includes 43 mines that have reached the stage of production but are now shut down. In most of these, the property is idle awaiting funds for development. Estimates for the total number of inactive mills in Canada run as high as 68. The time when this slack will be taken up can be determined only by finances, which also limit the activity of prospecting. With more than 2,000,000 sq. mi. generally favorable for ore deposition, the Dominion could conceivably double the present rate of production over the next ten years if outside capital could be attracted. That much money is not available in Canada.

Table I—Canadian Mines Planning Production in 1940

Mining Property	Proposed Mill Capacity
ONTARIO	
Addington Mines (Rich Rock)	200
Aunor Gold Mines (*h*)	300
Devon Gold Mines	75
Elizabeth Gold Mining Co	50
Faymar Gold Mines	200
Hiawatha Gold Mines	20
Martin Bird Gold Mines	300
Upper Seine Gold Mines	70
QUEBEC	
Claverny Gold Mines	75
Senator Rouyn Mines	125
NOVA SCOTIA	
Hillag Gold Mines	25
MANITOBA	
Flin Flon Gold Mines	100
Sunbeam Kirkland Gold Mines	130
BRITISH COLUMBIA	
Canty Gold Mines	50
Central Zeballos Gold Mines	25
Musketeer Mines	25
Windsor Consolidated	25
Utica Mines	50

British Columbia gold production is estimated to exceed $22,000,000 for 1939, compared with $21,000,000 the year before. In base-metal output the province is getting the benefit of war demands and general industrial expansion.

Quebec gold production is estimated at about 1,000,000 oz. in 1939, compared with a value of $30,374,855 in 1938. Asbestos output advanced 59,733 tons to 332,080 tons for the first eleven months. Byproduct silver declined slightly, and cement, lime, and clay products all showed excellent gains in the past year. Total value of Quebec mineral production is expected to exceed $75,000,000 in 1939, which is more than three times the increase shown by the country as a whole.

Ontario gold production for 1939 has an estimated value of $109,245,000, against $101,945,441 in 1938. Clay products, structural materials, and non-metallics increased from $22,020,079 in 1938 to an estimated value of $25,168,870 in 1939. A new all-time high in the history of Ontario is seen in the 1939 output of metals, estimated at $212,345,000 including appreciable gains for copper, nickel, and cobalt. Production of platinum metals was 34 per cent ahead of 1938, but did not quite offset the heavy price reductions in the first nine months of 1939. Iron mining was again started in Ontario in July, when the 2,000-ton sintering plant of Algoma Ore Properties, Michipicoten Harbor, Lake Superior, began treating ore from the Helen mine. Ontario contributes more than 60 per cent of Canada's gold output, of which only a tenth comes from junior producers developed in the last decade and more than eight-tenths comes from the fourteen old established operators in Porcupine and Kirkland Lake.

The excess-profits tax imposed as a war measure threatens serious interference with many mine operators. Objections by the mining industry point to the dangerous principle of a capital-gains tax and until the 32B Clause of the Income Tax Act is amended, the potentially large expansion of mining will be held back. In the first two months after introducing this much criticised legislation each case has been examined on its own merits at Ottawa, with the atti-

Table II—Canadian Metal Mines Producing in 1939

Mining Company	Gold Recovery per Ton 1938	Working Costs per Ton 1938 (*ee*)	Daily Tonnage 1939	Mill Capacity 1939	Dates of First Production
ONTARIO					
Amherst Gold Mines (Algold) (*g*)	3.76	.....	50	100	June, 1936
Algoma Ore Properties (Siderite)	.....	.....	.....	2,000	July, 1939
Bankfield Cons. Gold Mines	13.64	8.40	131	145	May, 1937
Berens R. Mines (*ai*)	16.38	.....	194	225	Sept. 1939
Bidgood Cons. Gold Mines (*ai*)	7.05	.....	158	160	July, 1934
Broulan Porcupine Mines (*ai*)	8.58	.....	253	300	Nov., 1939
Buffalo Ankerite Gold Mines	8.19	5.09	1,037	1,100	June, 1926
Central Patricia Gold Mines (*c*)	15.84	10.18	278	350	June, 1934
Chesterville Larder Lake Gold (*ai*)	5.50	3.30	510	540	1939
Clark Gold Mines (*g*)	.....	.....	.....	35	April, 1938
Cline Lake Gold Mines (O'Brien)	9.59	6.31	200	250	July, 1938
Cochenor-Williams Gold Mines	.....	.....	.....	150	Feb., 1939
Coniaurum Gold Mines (*j*)	8.75	5.99	542	600	May, 1928
Cordova Gold Mines (*r*)	.....	.....	.....	125	1939
Deep Lake Gold Mines (*g*)	.....	.....	.....	140	1938
Delnite Mines (Sylvanite) (*rr*)	6.41	5.70	192	320	June, 1937
DeSantis Porcupine Mines (*ai*)	8.24	.....	152	155	May, 1939
Dome Mines	12.12	4.26	1,711	1,750	1910
Elora Gold Mines (*g*)	2.11	.....	25	60	1936
Gillies Lake-Porcupine Mines	7.82	.....	51	100	May, 1935
Gold Eagle Gold Mines	7.41	7.39	98	150	Oct., 1937
Golden Gate Mining Co. (*ab*)	15.10	8.68	70	150	May, 1938
Hallnor Gold Mines (Noranda)	22.45	4.75	297	400	June, 1938
Hard Rock Gold Mines	8.52	.....	217	300	Jan., 1937
Hollinger Cons. Gold Mines	8.93	4.86	4,792	5,700	1910
Howey Gold Mines	2.67	1.25	1,280	1,500	April, 1930
J. M. Cons. Mines (Jackson Manion)	8.06	.....	98	100	Aug. 1936
Jason, G. M. (Argosy) (*g*)	.....	.....	.....	125	
Kenricia Gold Mines	.....	.....	.....	100	1939
Kerr-Addison Gold Mines	6.63	3.85	609	1,200	May, 1938
Kirkland Lake Gold Mines	16.01	6.70	265	400	1919
Lake Shore Mines (*ss*)	16.19	5.99	2,578	2,500	1918
Lebel Oro Gold Mines (*b*)	6.35	.....	64	110	April, 1937
Leitch Gold Mines	23.21	11.46	84	115	Jan., 1937
Little Long Lac Gold Mines (*c*)	15.93	11.46	216	300	Dec., 1934
Macassa Mines (*c*)	15.98	9.82	411	450	Oct., 1933
Mace Gold Mines (Vipond)	4.31	4.23	290	300	1911
MacLeod-Cockshutt Gold Mines (*ai*)	9.00	4.50	630	630	April, 1938
Madsen Red Lake Gold Mines (*ag*)	6.92	4.25	372	400	Aug., 1938
Magino Gold Mines (Algoma Summit)	.....	.....	.....	250	Nov., 1939
Magnet Cons. Gold Mines (*ai*)	27.75	.....	140	160	1939
Matachewan Cons. Mines (*j*)	5.39	4.14	423	450	Nov., 1934
McKenzie Red Lake Gold Mine (*c*)	14.09	9.14	181	225	Mar., 1935
McIntyre Porcupine Mines	9.39	4.84	2,440	2,550	1912
Minto Gold Mines (Jubilee) (*g*)	9.65	5.87	52	115	June, 1931
Moneta Porcupine Gold Mines	15.52	6.85	100	200	Jan., 1938
Morris Kirkland Gold Mines (*g*)	5.63	8.12	99	125	Oct., 1936
Naybob Gold Mines (Hayden) (*ai*)	10.00	3.50	150	150	1935
New Golden Rose Gold Mines (*mm*)	12.33	12.99	115	125	July, 1937
Northern Empire Mines (Newmont)	13.55	8.63	167	200	Mar., 1934
Omega Gold Mines (Castle-Treth)	4.67	3.88	464	525	1936
Pamour Porcupine Mines (*h*)	7.40	3.32	728	1,500	May, 1936
Paymaster Cons. Mines (*ag*)	7.60	.....	570	575	Oct., 1934
Pickle Crow Gold Mines (*c*)	23.89	11.45	308	400	April, 1935
Porcupine Lake Gold Mines (*g*)	5.65	.....	.....	40	1937
Preston East Dome Gold Mines (*ai*)	31.53	.....	411	425	1939
Raven River Gold Mines (*ll*) (*g*)	8.67	.....	65	75	Nov., 1937
Red Lake Gold Shore Mines (*Hasaga*)	9.48	7.16	132	150	Sept., 1936
Ross (Hollinger) (Cons)	11.22	6.02	100	200	Jan., 1936
Sachigo River Exploration Co. (*aaa*)	60.12	.....	30	50	May, 1938
Sand River Gold Mining Co. (*ai*)	11.74	9.32	94	110	Dec. 1937
St. Anthony Gold Mines	7.60	7.24	80	110	Aug. 1927
Straw Lake Beach Mines	11.85	8.50	54	70	Nov., 1938
Sturgeon River Gold Mines (*ag*)	17.06	11.37	75	85	April, 1937
Sylvanite Gold Mines (##) (*c*)	12.48	7.10	450	550	July, 1927
Tashota Goldfields (*g*) (*bb*)	8.51	.....	40	90	April, 1935
Teck-Hughes Gold Mines	10.62	.....	1,102	1,300	1917
Tionaga Gold Mines	.....	.....	.....	50	Dec., 1938
Toburn Gold Mines (i) (*c*)	21.21	11.52	103	150	April, 1913
Tombill Gold Mines (Newmont) (*ai*)	19.25	.....	110	115	Feb., 1938
Tyranite Mines	.....	.....	.....	200	1939
Uchi Gold Mines	.....	.....	.....	525	May
Upper Canada Gold Mines (*ai*)	15.63	.....	147	160	Nov., 1938
Wendigo Gold Mines (*ag*)	12.11	8.04	83	100	Jan., 1936
Wright-Hargreaves Mines (##, *c*)	17.95	8.95	1,198	1,200	May, 1912
Young-Davidson Mines (*z*)	3.48	2.37	1,000	1,000	Sept., 1934
International Nickel Co. (*pp*)	.....	.....	16,334	18,000	1916
Falconbridge Nickel Mines (*j*) (*nn*)	.....	5.74	1,403	1,450	Feb., 1930
Zenith Molybdenite Corp. (*cc*) (*g*)	.....	.....	25	50	Aug., 1937
NOVA SCOTIA					
Avon Gold Mines (Oldham) (*b*)	.....	.....	(*l*)	125	May, 1936
Caribou Gold Mines (*r*)	.....	.....	(*l*)	35	1934
Desales Mining Synd.	.....	.....	.....	20	1938
Guysborough Mines (*j*) (*k*)	7.83	6.14	89	100	1934
Higgins & Lawlor (*b*)	.....	.....	.....	20	1938
Lacey (Government project)	.....	.....	.....	35	1934
Mineral Industries (Wine Harbor) (*b*)	.....	.....	(*l*)	75	May, 1937
Montague Gold Mines (*g*)	6.69	4.33	(*l*)	200	1933
Nova Scotia Gold Mines (Tangier) (*g*)	.....	.....	(*l*)	100	1936
Nugold Mining Corp. (Blockhouse Dome) (*b*) (*g*)	.....	.....	(*l*)	35	Jan., 1937
Otter Lake Gold Mines (*g*)	.....	.....	(*l*)	75	July, 1937
Queens Mines (*g*)	.....	.....	(*l*)	50	1935
Seal Harbor Gold Mines	3.20	2.50	229	250	Aug., 1936
United Goldfields of N. S. (Brookfield) (*b*) (*g*)	.....	.....	(*l*)	25	Feb., 1934
Waverley Cons. Gold Mines (Lake Thomas) (*b*) (*g*)	.....	.....	(*l*)	75	1937
QUEBEC					
Amm Gold Mines	.....	.....	.....	1s0	1939
Aldermac Copper Corp. (*d*, *qq*)	.....	2.03	1,000	1,200	Jan. 1937
Arntfield Gold Mines (*ai*)	3.36	3.09	301	400	Aug., 1935
Beattie Gold Mines (*j*) (*x*)	3.85	2.20	1,731	1,800	May, 1935
Belleterre Mines (McIntyre)	7.77	.....	.....	220	Aug., 1936
Canadian Malartic Gold Mines (*j*)	4.66	2.72	696	750	May, 1935
Central Cadillac Mines (*ah*)	.....	.....	.....	200	
Cournor Mining Co. (Bussieres) (*b*) (*kk*)	5.46	4.00	200	210	Sept., 1937
East Malartic Mines (*ai*)	7.29	.....	1,114	1,500	Nov., 1938
Francoeur Gold Mines	5.37	4.13	.....	180	July, 1938
Jacola Gold Mines (Greene-Stabell) (*g*)	.....	.....	70	100	Dec., 1933
Lake Rose Quebec Mines (*g*)	.....	.....	.....	25	June, 1938
Lamaque Mining Co. (Teck-Hughes) (*c*)	11.59	7.38	1,078	1,300	April, 1935
Lapa Cadillac Gold Mines (*ai*)	4.73	3.71	185	300	July, 1938
Noranda Mines (*af*)	6.13	.....	3,588	6,000	Dec., 1927
Normetal Mining Corp. (*e*, *jj*, *vv*)	.....	4.22	386	500	Sept., 1937
Malartic Gold Fields	.....	.....	.....	300	1939
McWatters Gold Mines (*mm*)	11.05	11.34	107	200	Sept., 1934
Molybdenite Corp. of Canada (*g*)	.....	.....	.....	30	1938
O'Brien Gold Mines (**)	24.01	7.44	154	170	Sept., 1934
Pan Canadian Gold Mines (*g*)	.....	.....	.....	75	1938
Payore Cons. Mines (*g*)	.....	.....	.....	75	May, 1938
Perron Gold Mines (*c*) (*ag*)	10.90	7.48	368	375	April, 1934
Powell Rouyn Gold Mines (*n*) (*ll*)	5.56	.....	400	.....	1937
Sigma Mines (Dome) (*k*)	8.05	3.99	624	650	Mar., 1937
Siscoe Gold Mines (*ag*)	8.99	5.31	604	625	Jan., 1929
Sladen-Malartic Mines (*ai*)	4.03	3.70	651	655	Jan., 1938
Stadacona Rouyn Mines	5.03	4.18	440	500	Nov., 1936
Sullivan Cons. Mines	13.86	8.12	152	300	May, 1936
Thompson Cadillac Mining Corp. (*g*)	5.08	.....	70	215	June, 1936
Waite Amulet Mines (*h*, *vv*)	.....	.....	500	1,000	June, 1937
Wood Cadillac Mines	.....	.....	.....	225	1939
MANITOBA					
Beresford Lake Mines (*g*)	.....	.....	42	75	1937
God's Lake Gold Mines (*yy*)	11.43	7.90	196	200	Sept., 1935
Gunnar Gold Mines (*c*)	12.02	8.88	142	150	April, 1936
Gurney Gold Mines (Wylie-Dominion)	11.11	.....	139	140	Oct., 1937
Laguna Gold Mines (Rex) (*c*)	17.89	10.56	92	100	Aug., 1936
San Antonio Gold Mines (*c*)	9.39	6.54	321	335	July, 1932
Hudson Bay Min. & Sm. (Flin Flon) (*dd*, *mm*)	.....	5.89	5,000	5,200	Sept., 1930
Sherritt Gordon Mines (*b*, *f*, *ff*)	.....	.....	1,500	1,500	Aug., 1937
SASKATCHEWAN					
Athona Mines (*g*)	.....	.....	.....	15	1936
Box Mine (Cons. Smelters)	.....	.....	.....	1,500	1939
Monarch Gold Miners Synd. (*g*)	.....	.....	.....	25	1938

tude that the mineral industries are not expected to bear an unequal share of the burden of war taxes.

In 1940 higher operating costs are to be expected, particularly on foreign-made equipment, most of which comes from the United States. The Wartime Prices and Trade Board has demonstrated its policy to hold living costs at reasonable levels. No economic basis for higher wage demands is indicated for 1940, with little prospect of a labor shortage.

The search for new mines continues, but with an increasing percentage of effort being directed by the exploration departments of established mining companies. Diamond drilling and geophysical prospecting in concealed areas adjacent to producing mines have been resorted to, particularly in the Rouyn and East Porcupine districts. Progress in 1939 was for the most part in pushing out from the known ore conditions of the Malartic, Cadillac, Duparquet, and Noranda areas of Quebec, in Patricia, Kirkland Lake, and Timmins areas of Ontario, north of the Sherritt-Gordon mine, in Manitoba, and in two British Columbia districts (south of the Zeballos camp and near Alberni Canal, both on Vancouver Island).

First commercial production of lode gold from Saskatchewan was reported in 1939 from the Box property, on Lake Athabasca. The Northwest Territories are now producing at the annual rate of more than $2,000,000 in gold, in addition to assuming world leadership in the output of radium, and larger developments are in prospect. Yukon Territory has an estimated output of alluvial gold valued at about $3,000,000 for the year, with ten dredges in operation in the Klondike and one dredge in the Sixtymile River area.

Power consumption in the mining districts of northern Quebec and Ontario is approximately 200,000 hp. a year, with an annual increase of more than 30,000 hp. A wealth of

Table II—Canadian Metal Mines Producing in 1939

Mining Company	Gold Recovery per Ton 1938	Working Costs per Ton 1938 (*ee*)	Daily Tonnage 1939	Mill Capacity 1939	Dates of First Production
BRITISH COLUMBIA					
Aztec Mining Co. (B.R.X. Gold)	.....	.....	.....	150	May, 1938
Brooklyn Stemwinder Gold Mines	.....	.....	.....	60	1939
Bealemore Milling Co. (Wayside) (*g*)	.....	.....	.....	150	Nov., 1934
Bralorne Mines (*q*)	19.82	10.17	501	550	Feb., 1932
Caribou Gold Quartz Mining Co. (*ai*)	11.75	7.59	305	310	Jan., 1933
Caribou-Hudson Gold Mines (*g*)	10.01	.....	50	100	Dec., 1938
Columbia Tungstens	.....	.....	.....	25	1939
Cons. Nicola Goldfields (Jenny Long) (*g*)	.....	.....	.....	75	193.
Dentonia Mines (Durango) (*u*) (*g*)	.....	.....	.....	100	Jan., 1938
Fairview Amalg. Gold Mines (*tt*)	4.23	3.61	100	150	1936
Gold Belt Mining Co. (*kk*)	16.74	4.50	147	150	Oct., 1938
Gold Mountain Mines (Hedley) (*g*)	5.43	.....	(*l*)	50	Dec., 1936
Grange Cons. Mines (Pavilion Mt.) (*g*)	.....	... ..	.....	50	Oct. 1934
Greenbridge Gold Mines	.....	.....	.....	100	1938
Greenwood Ore Concentrating Co	.....	.....	.....	50	
Hedley Mascot Gold Mines (*a, t*)	13.76	5.95	183	200	May, 1936
Highland-Bell (*f*) (*hh*)	.....	.....	.....	.....	1930
Island Mountain Mines (Newmont) (*ag*)	15.10	8.91	128	150	Nov., 1934
Kamloops Homestake Mines (*u, g*)	14.03	.....	(*l*)	50	1936
Kelowna Exploration Co. (Nickel Plate) (*s*)	.....	.....	200	225	1934
Kootenay Belle Gold Mines (*u, b*) (*ll*)	13.96	.....	134	150	Dec., 1934
Mount Zeballos Gold Mines	.....	.....	.....	35	1939
New True Fissure Min. & Mill (*u*) (*g*)	.....	.....	.....	100	Oct , 1937
Nicola Con. Goldfields	.....	.....	.....	75	1939
Osoyoos Mines	16.45	.....	(*l*)	150	Oct., 1935
Pioneer Gold Mines of B.C. (##) (*c*)	16.52	10.55	350	400	1928
Polaris Taku Mining Co	12.00	.....	.....	225	1938
Porcher Island Mines (Reward) (*g*)	.....	.....	.....	50	Jan., 1939
Privateer Mines (*ai*)	37.11	8.97	76	80	Oct., 1938
Quesnell Quartz Mining Co	.....	.....	.....	25	Jan. 1939
Relief Arlington Mines (*i*) (*ag*)	16.84	.....	84	90	1933
Reno Gold Mines	19.92	10.46	120	140	Aug., 1929
Reward Mining Co. (Surf Point) (*b*)	12.34	.....	(*l*)	25	Feb., 1937
Rey Oro Gold Mines (*g*)	140.00	.....	5	15	1938
Sheep Creek Gold Mines (Queens) (*c*) (*a*)	17.86	10.53	148	150	May., 1935
Silbak Premier Mines (*i, m*) (*ag*)	9.77	5.33	473	550	1919
Skidegate Gold Mines (*g*)	.....	.....	.....	70	1937
Spider Gold & Silver Mines (*g*)	.....	. ....	.....	50	1938
Spud Valley Gold Mines (*ai*)	25.81	.....	6	75	Nov., 1938
Surf Inlet Cons. Gold Mines (*ag*)	14.93	.....	75	100	April, 1936
Vancouver Island Gold Mines	.....	.....	.....	25	1938
Velvet Gold-Copper Mines (*a*) (*g*)	.....	.....	.....	100	1932
Vidette Gold Mines (*a*)	.....	.....	70	80	Dec., 1935
Wesko Mines (Central Star) (*u, g*)	7.89	6.02	90	100	Nov., 1936
Western Exploration Co. (*g*)	.....	.....	.....	150	1938
Wilcox Mining Synd. (*u*)	16.50	.....	12	20	1934
Windpass Gold Mining Co	.....	.....	40	50	Jan., 1934
Ymir Cons. Gold Mines (Goodenough) (*u*)	.....	.....	30	100	July, 1935
Ymir Yankee Girl Gold Mines (*u, uu*)	9.79	8.22	125	140	July, 1934
Cons. Mining & Smelting Co. (Kimberley) (*p*)	.....	.....	(*l*)	6,600	1906
Cons. Mining & Smelting Co. (Tadanac) (*a, y*)	.....	.....	(*l*)	2,400	1906
Britannia Mining & Smelting Co. (*a, p, w*)	.....	.....	(*l*)	6,000	1903
Base Metals Mining Corp. (*b, p, e*) (*g*)	.....	.....	(*l*)	300	Nov., 1937
Granby Cons. Min. & Sm. (Allenby) (*a, b, oo*)	.....	.....	(*l*)	3,000	June, 1937
Noble Five Mines (Slocan) (*b, u*)	.....	.....	(*l*)	100	Aug., 1935
Buena Vista Mining Co. (Big Missouri) (*r, ii*)	3.22	.....	630	750	April, 1938
NORTHWEST TERRITORIES					
Bear Exploration & Radium (*t, **)	.....	.....	.....	35	Oct., 1935
Con. Mine (*r*)	.....	.....	.....	100	1938
Eldorado Gold Mines (Pitchblende-silver) (*c*)	.....	.....	70	150	1933
Negus Mines	.....	.....	.....	50	Feb., 1939

(*a*) Copper-gold producer. (*b*) Former producer. (*c*) Costs include all charges. (*d*) Shipping copper and sulphur concentrates. (*e*) Controlled by Mining Corp. of Canada. (*f*) Copper-gold-silver producer. (*g*) Production temporarily suspended. (*h*) Controlled by Noranda Mines. (*i*) Controlled by Premier Gold Mining Co., one of the 10 principal foreign development companies of American Smelting & Refining Co. (*j*) Controlled by Ventures, Ltd., 45% in Beattie Gold. (*l*) Not reported. (*m*) Controlling 5 mines in Portland Canal area, including the Premier, largest Canadian silver producer. (*n*) Shipping to Noranda smelter. (*o*) Approximate monthly output, silver, 80,000 oz.: radium, 3 grams: in 1935, 296 tons concentrates: in 1936, 401.5 tons: in 1937, 668.6 tons. Value of radium, silver, and uranium produced in 1937, $850,000. (*p*) Silver-lead-zinc producer. (*q*) Also treating ore from Bradian Mine. (*r*) Controlled by Cons. Mining & Smelting Co. of Canada. (*s*) Formerly largest B. C. gold producer. (*t*) Silver producer. (*u*) Gold-silver-lead-zinc producer. (*v*) First four months 1937. (*w*) Controlled by Howe Sound Co. (*x*) Controlled by Nipissing Mines. (*y*) At Trail, B. C., are located customs concentrator, zinc production plant and refinery, copper smelter and refinery, lead smelter and refinery, fertilizer plant, etc. (*z*) Subsidiary of Hollinger Cons. Gold Mines. (#) Combined with Marbuan, formerly March Gold Mines. (*aa*) Mining costs per ton, 1936. (*bb*) Excluding 182,514 lb. copper in concentrates shipped 1937. (*cc*) Mill operated Aug.-Nov. 1937. (*dd*) Ore milled in 1937 averaged 2.17% Cu, 4.7% Zn, 0.107 oz. Au, 1.52 oz. Ag. Smelter byproducts were cadmium, selenium, tellurium. (*ee*) Before taxes, depreciation, depletion. (*ff*) Net costs of electrolytic copper in 1937. 7.097c. per lb., net loss on 5-month period $80,549 after depreciation and deferred development: concentrates shipped to Flin Flon. (*gg*) First quarter, 1938. (*hh*) First half, 1938. (*jj*) Copper concentrates treated at Noranda, zinc concentrates in England. Ore in 1938 averaged 2.45% Cu: 8.265 Zn; 0.03 oz. Au; 3.03 oz. Ag. (*kk*) Figures for Jan. 1939. (*ll*) For first 11 months, 1938. (*mm*) Including depreciation. (*nn*) Gross operating profit. (*oo*) Costs in 1937 were 9.41c. per lb. of copper on 10,451,364 lb. (*pp*) Production in 1937 came from Frood, Creighton, Levack, and Garson mines. Total metal sales were; nickel, 207,700,943 lb.: copper, 291,880,403 lb.: silver, 2,356,170 oz.: gold, 75,849 oz.: platinum, 188,756 oz.: selenium, 81,334 lb.; tellurium, 4,423 lb. (*qq*) Average ore grade 1.97% Cu, 0.011 oz. Au, 0.435 oz. Ag, and 50% sulphur concentrates: a 50-ton plant for recovering elemental sulphur now being built: operating costs shown for March, 1938. (*rr*) For first 10 months' operation. (*ss*) For first fiscal year ended June 30, 1938. (*tt*) For June, 1938. (*uu*) For fiscal year ended Aug. 31, 1938. (*vv*) Copper-zinc-gold producer. (*ww*) For first 9 months, 1938. (*xx*) For fiscal year ended Aug. 31, 1939. (*yy*) For first 10 months, 1938. (*zz*) For fiscal year ended Oct. 31, 1938. (*s s*) For fiscal year ended Mar. 31, 1939. (*) Av. monthly output in 1938, 50,000 oz. Ag, 11% uranium in concentrates. (**) For fiscal year ended Oct. 1, 1938. (*aaa*) For first 6 months production. (*ab*) For first 8 months operation. (*ac*) Fiscal year ended May 31, 1939. (*ad*) Except taxes. (*ae*) 8,012.7 tons nickel, 4,108.5 tons copper in matte produced, 1938: ore grade 1.80% nickel. 0.94% copper. (*af*) Total 1938 production 76,358,442 lb. Cu: 299,033 oz. Au: 607,447 oz. Ag: plus recoveries from 221,498 oz. customs ore. (*ag*) First 11 months 1939. (*ah*) Operating Thompson Cadillac Mill. (*ai*) For Nov. 1939.

water power has been a deciding factor in the successful development of a large percentage of Canadian mines. Hydro-electric transmission lines across the mineral belts may be expected to continue with an adequate supply of low-cost power for increasing future demands. In Quebec, the Provincial Government has made an initial venture into the power business on the upper Ottawa River, within reach of the Noranda-Lamaque district.

Road construction has been lagging in many parts of the new mining frontier, in spite of large appropriations by both Federal and Provincial treasuries. Roads under construction to Chibougamau from Lake St. John and from Montreal to Senneterre, in Quebec, are not yet completed and several other vital road sections in Quebec mining districts have been in hazardous condition. The large construction program in Ontario will soon have continuous pavement on the new Ferguson Highway, from Toronto to Larder Lake and Timmins. The Little Long Lac camp has a fine new road link and plans have been made for a 100-mile highway to mines north of the track in the Patricia district.

Dividends paid by Canadian mining companies show a grand total of more than $1,000,000,000, as shown in Table III. In the past year eleven new dividend payers swelled the list

(*Continued on page* 96)

Table III—Cumulative Dividend Record of Canadian Metal Mines (a)

Province and District	1935	1936	1937	1938	1939	Total to End of 1939
ONTARIO:						
Sudbury	$13,866,659	$21,886,752	$37,776,054	$32,103,201	$32,103,201	$293,899,690
Cobalt (*c*)	150,000	600,000	444,000	180,000	180,000	107,162,442
Porcupine	9,952,883	11,021,672	12,169,765	12,675,188	14,252,967	172,204,316
Kirkland Lake	14,584,641	16,989,780	20,259,277	16,299,277	16,040,989	153,356,293
Patricia	420,000	1,652,900	2,714,950	3,095,661	3,453,900	11,847,900
Matachewan	.....	.....	.....	.....	31,682	31,682
BRITISH COLUMBIA	$11,147,258	$16,752,784	$17,550,778	$13,890,001	$13,589,705	$205,909,026
QUEBEC	5,544,898	8,114,999	8,951,527	11,287,335	13,861,015	66,747,217
MANITOBA	3,228,734	3,082,517	5,230,586	4,773,541	5,852,234	22,279,828
NOVA SCOTIA (*b*)	.....	.....	.....	.....	.....	47,928
MISCELLANEOUS	568,818	1,011,560	1,579,552	1,176,893	588,160	5,593,338
Totals	$59,364,889	$81,112,948	$104,637,160	$95,481,097	$100,953,853	$1,039,079,660

(*a*) Data compiled by *Northern Miner*. (*b*) Paid in 1900; dividend record incomplete. (*c*) Since 1933, paid by Nipissing Mines, a holding company.

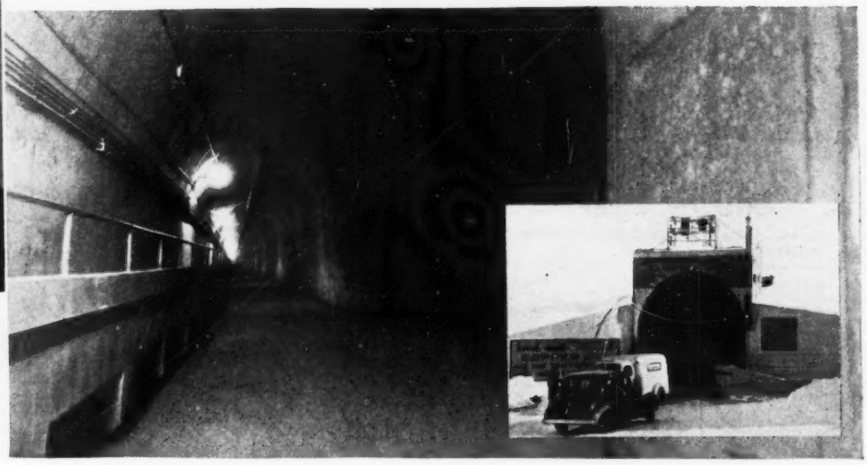
It Happened in

As a result of efforts of Senator Carl Hayden of Arizona (photo), and others, 1939 saw the end of the seven-year period in which the legal requirement as to performance of assessment work on mining claims was suspended *(Photo by Harris and Ewing)*

Hydraulic mining in California hopes to thrive again, once the debris dams authorized by law have been built. The North Fork dam, here seen, was completed in 1939 and construction of the Upper Narrows dam was started

A new Experiment Station was built for the Bureau of Mines at Salt Lake City. To it have been transferred from Washington the headquarters of the Bureau's Metallurgical Division. The portrait at the right is that of R. S. Dean, chief engineer of the Division. *(Latter photo by Harris & Ewing)*

A Secondary Metals Section was established by U. S. Bureau of Mines at its Pittsburgh Experiment Station, with James S. Earle (above) in charge



Utah Copper Company completed this 7,000-ft. tunnel for vehicles and pedestrians between Copperfield and Bingham, Utah, where its famous mine is situated

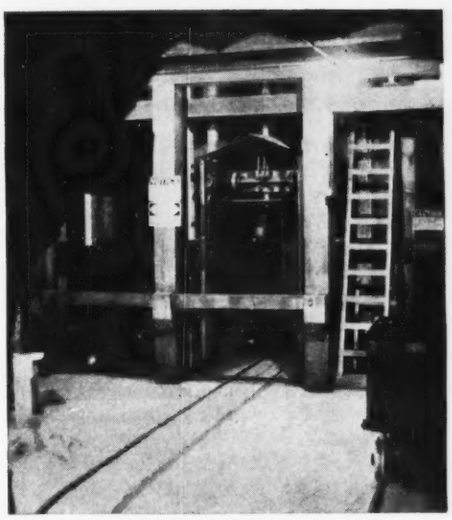
1939

Strategic minerals held the limelight in 1939, among them manganese. Up to the end of the year the only successful bidder for supplying the latter for stockpile purposes was the Cuban-American Manganese Corporation (plant in photo), which brings its foreign manganese in duty-free. This company received a contract for supplying 25,000 tons of 50 per cent concentrates. Photograph by courtesy of the company

Finland's now-famous copper mine at Outokumpu, the "Queer Hill", was threatened by Soviet invasion. Shafthouse and mills are perched on the eminence like a medieval castle. The smelter is at the left. *(Photo by Therese Bonney)*

At Columbia University, the 75th anniversary of the founding of its School of Mines and the Schools of Engineering that grew from it was celebrated

Britain's King and Queen visited the Sudbury nickel district in Ontario. The royal couple is here seen at the Frood mine with Donald MacAskill, International Nickel's vice president and general manager, and (in the rear, above) R. D. Parker, general superintendent. *(Wide World Photo)*

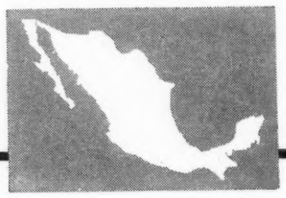


The mining industry was publicized in various ways at the New York World's Fair and San Francisco's Exposition. Above, a detail from the latter's Treasure Mountain exhibit

Electrolytic manganese was first produced, under license from U. S. Bureau of Mines but on a commercial scale, by Electro Manganese Corporation in this plant at Knoxville, Tenn. K. M. Leute (portrait) is president

MEXICO

Drop in silver price and war in Europe have severe effects on both the Government and the mining companies. Taxation and wages increase



A. H. HUBBELL
Associate Editor

FORTUNE smiled less brightly in 1939 on those groups in Mexico which have been responsible in the last five years for creating conditions of operation for the country's mining industry so onerous as to suggest that expropriation was the ultimate objective. In no way, however, did this improve the situation for the mining companies. For both sides the twelve-months' period was one of uncertainty and disappointment. That the year in which Washington's silver policy was due for review should also be the year in which a new world war should start proved doubly unfortunate. As a result of the first circumstance the price of silver fell. The second dislocated the channels of trade for the mining industry, bringing changes in the flow of metals that were not completed at the year's end. As an outcome of both, the production of silver and lead declined, local disturbances also contributing in the first quarter, this reducing the income of the mining companies and the revenue of the Government as well as decreasing the volume of dollar exchange that the latter was able to obtain, with consequent impact upon its finances and the value of the peso. The war, moreover, interrupted the country's exports of petroleum to the Continent, causing further financial difficulties. Yet this chastening brought no change in the attitude of the Administration and of labor. The outstanding dispute as to payment for the foreign-owned petroleum properties expropriated in March, 1937, remained unsettled, the highest Court finally upholding the seizure. Thus the further conduct of the matter was put up to the State Department at Washington. And late in the year, the dominant Party of the Mexican Revolution, at its convention, approved a second "six-year plan" to serve as a guide for the successor to the present Administration in the approaching election, a plan that, according to newspaper comment in Mexico itself, shows a general tendency "to impose a totalitarian contralizing regime, predominant in every order."

Mexico's production of refined silver in 1939 is placed at 76,500,000 oz., compared with 81,016,939 oz. reported by the American Bureau of Metal Statistics for 1938. This reduction reflects the decline in the world price of the metal from 43c. to 35c. an ounce that followed the action of the United States Senate on June 26 in respect to purchases of foreign silver, a decline that reduced the dollar exchange derived by Mexico from the sale of silver and the amount of taxes levied on its production and export.

Lead output is estimated for the year at 230,000 short tons (based on unrefined lead production), compared with 267,530 tons reported by A.B.M.S. in 1938. The entire output was exported. Production of slab zinc rose from 41,338 in 1938 to 43,000 tons, marketing difficulties causing some accumulation of concentrates. The output of gold increased from 923,000 oz. to 1,045,000 oz., some large shipments being made due to accumulations. Production of copper rose to 47,500 short tons from 45,662 in 1938.

Up to the close of the year, the war had only an adverse affect upon mining in the Republic. Prior to hostilities the country's lead and zinc were sold in Europe. This was rendered difficult with the fixing of maximum prices by the belligerents, the scarcity of shipping and the rise in ocean freight rates, and insurance.

Labor disputes and strikes appear to have been fewer in 1939, upon scanning the news of the year's events. This is ascribed by a well-informed correspondent to the accidental fact that the larger and more important number of labor contracts of the mining industry come due for revision (as they must every two years under the law) in even-numbered years, so that the relative quietness of 1939 was due to its being an unimportant year in this respect.

Average wages continued mounting. The 40,000 employees of the companies representing almost all of the country's output of metals, received approximately 8 pesos per day in 1939, counting 365 days per year, this in contrast with 6.54 pesos in 1938.

Co-operative mining societies continued to grow in number. The rank and file, it is said, would prefer to have their quondam employers responsible for the payments they formerly received. The wages, called "advances against profits," and per-

Official Values in Pesos of Principal Metals Used only for Purpose of Collecting 12% Export Tax

	Gold Per Kg.	Silver Per Kg.	Copper Per Kg.	Lead Per Kg.	Zinc Per Kg.
Dec. 1938–Jan. 1939	4,707.500	32.520	0.318	0.118	0.066
Jan.–Feb. 1939	4,707.500	38.811	0.326	0.101	0.063
Feb.–March 1939	4,707.500	32.520	0.324	0.093	0.063
March–April 1939	4,707.500	32.520	0.293	0.088	0.062
April–May 1939	4,707.500	32.520	0.301	0.093	0.063
May–June 1939	4,707.500	32.520	0.295	0.088	0.061
June–July 1939	4,707.500	32.521	0.293	0.093	0.063
July–August 1939	5,460.503	24.313	0.340	0.109	0.076
August–Sept. 1939					
Refined	6,472.748	0.000	.....	0.242	0.263
Concentrates	.....	.....	.....	.....	0.066
Mixed bars	.....	.....	0.865	0.142	.....
Sept.–Oct. 1939					
Refined	6,472.748	0.000	0.865	0.228	0.267
Concentrates	.....	.....	.....	.....	0.069
Mixed bars	.....	.....	.....	0.128	.....
Oct.–Nov. 1939					
Refined	5,599.264	0.000	.....	0.183	0.212
Concentrates	.....	.....	.....	.....	0.041
Mixed bars	.....	.....	0.973	0.096	.....
Nov.–Dec. 1939					
Refined	5,437.977	0.000	.....	0.149	0.193
Concentrates	.....	.....	.....	.....	0.038
Mixed bars	.....	.....	0.956	0.071	.....
Dec.–1939–Jan. 1940					
Refined	6,159.189	0.000	.....	0.271	0.238
Concentrates	.....	.....	.....	.....	0.051
Mixed bars	.....	.....	1.233	0.179	.....

This summary of conditions in Mexico is based on information received from reliable sources. Thanks are due those who have contributed. Their remarks at times are freely incorporated in the text.

quisites of the members are much inferior to those obtained under company operation, despite the fact that the co-operatives have been practically exempt from all taxation. The men, moreover, must work harder, indolence not being tolerated and protected by the Union and the Labor Law, as it was when the owners were in charge. Despite these results so unfavorable for the workers and the Treasury, the movement continues.

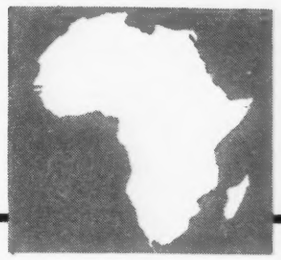
Taxation underwent decided changes. The appraisal values of the various metals established monthly by a committee for the purpose of levying the 12 per cent export tax were altered repeatedly during the year. They are given in the accompanying table. The estimated annual yield of this tax when it was established is said to have been about 30,000,000 pesos. At the year-end appraisal values, it should be approximately 40,000,000 pesos. In August silver was temporarily exempted from this tax, as shown, but the values of other metals were increased. Even without the silver export tax, the combined production tax on gold and silver plus the export tax on gold amounted to more than 15 per cent of the combined market value of the country's gold and silver output, according to an official.

Repeal of the 4 per cent tax on capital or funds sent abroad was effected, despite its annual yield of approximately 12,000,000 pesos, it being thought that the war would give Mexico an opportunity to attract new investors from abroad and that the tax was hindering new investment. In its place, an excess-profits tax went into effect, on Dec. 28, affecting annual profits of more than 100,000 pesos and retroactive with respect to profits of 1939. This, it is expected, will yield twice as much as the other tax. The schedule is as follows: Profits up to 15 per cent of "book worth" (difference between assets and liabilities) are exempt. From 15 per cent to 21 per cent, 15 per cent tax; from 21 to 27 per cent, 20 per cent tax; from 27 to 33 per cent, 30 per cent tax; in excess of 33 per cent, 35 per cent tax. In cases where liabilities exceed assets so that there is no "book worth," that part of the profits up to 20 per cent of the total will be exempt; from 20 to 25 per cent, 15 per cent tax; from 25 to 30 per cent, 20 per cent tax; from 30 to 35 per cent, 25 per cent tax; above 35 per cent, 30 per cent tax.

Under conditions such as those portrayed, new undertakings can hardly be expected. New investment would cause surprise. One is inclined to echo the remark of a prominent official who said recently: "There seems to be no change of heart. The drive is becoming more intense. The project of the new Six-Year Plan is very disconcerting."

SOUTH AFRICA

All branches of mining in Union show growth. Gold production sets new record. Improvements in operating practice fostered by research



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THE YEAR 1939 witnessed a steady growth in practically all branches of mining operations in the Union of South Africa. Pride of place, as usual, must be given to the wonderful gold-mining industry of the Witwatersrand, Transvaal, and of its extensions. Nevertheless, diamond, coal, silver, copper, platinum, and, to a lesser extent, lead and manganese mining, have held their own.

With the departure, in December, 1932, of the Union from the gold standard, a tremendous fillip was given to the mining industry, on which the prosperity of this Dominion is so largely dependent. The effect on the gold mining industry can best be gaged by studying Tables I and II. Outstanding features of these tables are:

(1), Progressive increase in the number of producing gold mines on the Witwatersrand and its extensions; (2), The ever-growing tonnage milled, due both to producing mines and new mines entering the producing stage; (3), The increased value of the gold produced.

Other important aspects are: (a) The marked increase in the total number of employees in the industry, both white and colored. (b) The large number of new shafts that have been sunk. (c) The large area proved, by geophysical prospecting and boreholes, to be auriferous on an economic scale.

Prospecting operations for gold in the Orange Free State Province have been encouraging.

Steady reduction in grade of ore sent to the mill is well illustrated. This has kept pace with the increase in price of gold and tonnage milled. The latter has been due to the increase in the number of producing mines and to increased milling capacity of some producers.

In all, about 40 new shafts have been sunk since the beginning of 1933. Two new mines became producers in 1939, and a third mine is expected to do so this year. The footage sunk on the Rand and its extensions during the period January-September 1939, aggregated 23,223 ft., compared with 30,220 ft. for the same period of 1938. Outstanding among the new shafts is the vertical six-compartment South Deep shaft of the Simmer and Jack. This is the deepest single shaft in the world, the total depth from the collar being 6,331 ft. Rope diameter is 2.1 in.

Included in Table I is the gold won from miscellaneous mines (Witwatersrand), as well as from other districts of the Transvaal. The monthly total from these sources averages 38,938 fine ounces for the first ten months of 1939, with minimum and maximum totals of 29,807 and 43,474 oz. per month respectively.

The table shows the constant efforts to maintain a minimum grade for the tonnage milled, and the success achieved, with the view to prolonging the life of the industry. Working costs per ton milled fluctuate within narrow limits, and the total working profits reflect progressive increases due largely to the increased tonnage milled and the rising price for gold. The Union Government has decided to appropriate the proceeds from the sale of gold exceeding 150s. per fine ounce.

Numerous records were established by individual mining companies during October, and by the industry as a whole. Examples are record tonnages milled and record profits won. It is anticipated that this year's gold output from the Transvaal will aggregate 12,750,000 oz., a new record. The output in 1938 was 12,156,629 oz.

The million-ounce mark per month

SOUTH AFRICA

was first reached in March, 1938, and, except for the short working month of February, 1939, has been maintained above this level, with the maximum output, in October, of 1,102,212 oz. Though production ruled higher on most properties, the maiden declaration of the Venterspost gold mine (10,045 oz.) carried the total 639 oz. beyond the record established in August. The yield for the first ten months totals 10,615,478 oz.

Efforts are continually being made to combat seasonal shortage of native labor (see Table I). With this end in view, the use of mechanical means for removing broken rock from stopes and development ends has been extended. Mechanical scraping is commonly used where conditions permit. Experiments conducted with natives from north of latitude 22 deg. S. (of whom 16,000 were employed by the industry in 1938) were successful.

Mining methods vary much in detail and range from resuing to so-called straight stoping. All modern methods have as main objectives: (1), Adequate support of roof or hanging wall; (2), Supply of ventilating currents to working areas only; (3), Elimination of the necessity to return to worked-out areas where some broken ore may have been left. With regard to (3), current sweeping operations are in vogue. Here, scatter piles or other forms of barrier are provided that confine the ore from the blast to a space between the pile or barrier and the working face of stopes.

A comparatively recent advance in development practice is the "drag cut." This type of cut, first introduced in an East Rand mine, has found favor in many mines. Advantages claimed are: (1), Longer rounds are blasted; (2), Saving in explosives; (3), Prevention of damage to equipment near the face.

The total footage developed in producing and non-producing mines on the Rand and its extensions for the first nine months of 1939 totaled 1,872,702, or nearly 355 miles, averaging 208,078 ft. per month.

Experiments extending over many years, with detachable bits (Jack bits) are bearing fruit. The difficult drilling conditions, due to hard and tough rock, have made the adoption of this form of bit proceed somewhat slowly. Satisfactory results have been obtained in some mines.

Practically every mine has its so-called study or planning department, in effect a research department, where every phase of mining operation is constantly studied. An outstanding feature of the industry is the pooling of new knowledge and publication of information as to fresh discoveries.

Study of first aid, as usual, receives close attention. Separate classes are provided for both whites and colored. During 1938, for example, 26,000 natives were awarded certificates after attending classes voluntarily. Annual competitions are arranged by the industry and the degree of proficiency attained is high. The accident death rate is low and has shown steady improvement in recent years.

Prevention of miners' phthisis is concentrated on, as usual, and improved methods of drilling, ventilation, and other cognate subjects are studied sedulously. The condition of mine air has received much attention in recent years. Some of the deeper mines are equipped with refrigerating plants. One plant is situated on the surface; the others have been placed underground. Each practice has its merits. The underground factors involved vary appreciably; but, in general terms, the main factors involved in atmospheric working conditions in deep mines resolve themselves into means of: (1), Reduction in temperature; (2), Reduction in relative humidity; (3), Increased air movement.

Preservation of mine timber has received its share of study and researches into this subject and that of the prevention of underground fires have been, and are continually being, conducted.

A most important aspect of local mining practice—namely, "face utilization" (that is, the number of fathoms obtained per 100 ft. of available stope face)—has been the subject of much thought and enterprise comparatively recently. The problem first arose when a new-comer to the ranks of producing mines was expected to provide 60,000 tons of ore for the mill from a limited footage of available stope face. The manager succeeded in fulfilling requirements by departing

Table III—Accident Death Rate

Year	Number of Deaths	Death Rate per 1,000 per Annum
1932	564	2.36
1933	594	2.35
1934	579	2.11
1935	607	2.02
1936	662	2.05
1937	696	2.12
1938	636	1.86
1939 (half-year)	362	1.96

Table II— Comparative Yearly Statistics Pertaining to the Witwatersrand Gold Field, 1932–1938

Item	1932	1933	1934	1935	1936	1937	1938
Number of producing mines	32	31	31	33	36	37	40
Tons milled	34,466,750	36,383,800	39,139,900	44,234,650	48,221,120	50,725,750	53,834,150
Total fine ounces gold	10,920,095	10,341,977	9,777,308	10,458,970	11,015,776	11,329,397	11,707,254
Pennyweight/ton milled	6.328	5.685	4.996	4.729	4.569	4.462	4.349
Declared revenue, total (£)	46,525,453	63,640,955	66,978,445	74,199,671	77,227,893	79,593,984	83,412,856
Declared revenue/ton milled	27/0d.	35/0d.	34/3d.	33/7d.	32/0d.	31/5d.	31/0d.
Total working costs (£)	32,755,157	34,946,144	37,611,123	41,773,656	45,317,911	48,008,241	51,724,900
Working costs/ton milled	19/0d.	19/3d.	19/3d.	18/11d.	18/9d.	18/11d.	19/3d.
Declared working profit — Total (£)	13,770,296	28,694,811	29,367,322	32,426,015	31,909,982	31,585,743	31,687,956
Declared working profit/ton milled	8/0d.	15/9d.	15/0d.	14/8d.	13/3d.	12/6d.	11/9d.
Estimated % of world gold production, Transvaal	48.4%	44.9%	38.3%	34.8%	32.4%	33.1%	33.1%
European labor employed	20,865	22,401	24,813	28,893	31,725	33,898	35,977
Colored labor employed	209,383	221,346	238,414	271,521	293,608	297,428	310,674
Salaries and wages, whites (£)	9,066,282	9,695,927	11,223,974	12,771,623	14,329,804	15,737,748	16,856,041
Wages, colored (£)	7,553,258	7,904,427	8,592,621	9,511,479	10,587,126	10,752,854	11,408,913
Death rate (*a*)							
Whites	1.36	2.12	1.89	1.49	1.59	1.21	1.46
Colored	2.37	2.31	2.05	2.36	2.16	2.20	1.94
Number of rock drills at work in Dec.	5,976	6,101	6,209	6,598	7,239	7,283	8,078
Explosives consumed							
Cases 50 lb. each	1,085,216	1,185,773	1,265,896	1,373,245	1,521,873	1,610,988	1,762,983
Total weight, tons	27,130	29,644	31,647	34,331	38,047	40,275	44,075
Total value (£)	1,853,077	1,934,123	1,986,035	1,992,941	2,137,353	2,203,906	2,470,418
Total value of stores consumed (£)	16,045,459	18,359,989	21,619,279	24,829,266	26,161,291	28,410,057	30,346,739

(*a*) Per 1,000 per annum, surface and underground.

Table I—Results Achieved by Gold Mining Industry of the Rand and Its Extensions and Other Districts of the Transvaal in 1939

1939	January	February	March	April	May	June	July	August	September	October
Number of producing mines	40	40	40	40	40	40	41	41	41	42
Tons milled	4,736,200	4,454,400	4,891,700	4,614,000	4,952,700	5,831,800	4,936,400	5,029,900	4,896,500	5,020,300
Total fine ounces of gold	1,038,717	979,128	1,075,807	1,017,182	1,083,843	1,064,284	1,080,741	1,101,573	1,071,991	1,102,212
Pennyweight per ton	4.210	4.262	4.227	4.263	4.218	4.237	4.211	4.217	4.232	4.218
Declared revenue, total (£)	7,422,868	7,044,785	7,668,055	7,301,748	7,748,812	7,595,148	7,710,765	7,869,152	7,800,121	7,968,591
Declared revenue, per ton	31/4d.	31/8d.	31/4d.	31/8d.	31/4d.	31/5d.	31/3d.	31/3d.	31/10d.	31/9d.
Total working costs (£)	4,549,871	4,331,617	4,729,281	4,494,864	4,787,043	4,683,024	4,754,027	4,825,850	4,742,227	4,878,048
Working costs/ton milled	19/2d.	19/6d.	19/4d.	19/6d.	19/4d.	19/4d.	19/3d.	19/2d.	19/4d.	19/5d.
Declared estimated working profit (£)	2,872,997	2,713,168	2,938,774	2,806,884	2,961,769	2,912,124	2,956,738	3,043,302	3,057,844	3,090,543
Declared working profit per ton milled	12/2d.	12/2d.	12/0d.	12/2d.	12/0d.	12/1d.	12/0d.	12/1d.	12/6d.	12/4d.
Number of whites employed	42,082	42,304	42,542	43,020	43,158	43,320	43,584	43,511	43,605	(*a*)
Number of colored employees	313,725	324,871	328,548	329,542	329,193	328,101	324,343	321,027	320,040	(*a*)

a Figures not available.

from the recognized "machine-shift breaking efficiency" and "fathoms per case of explosives" standards. He shortened the distance between stope benches from 8 ft. to 6 ft. and, in some cases, even less. For example, where one rock drill was boring, say, 30 holes per shift and so was not drilling over the whole face but was leaving a balance of, say, 15 or 16 holes that could not be drilled, the miner was provided with an additional rock drill to bore the remaining holes. The final result was that the cost per ton mined was actually lower than would ordinarily have been the case, because more productive work was being done, while the main standing charges remained constant.

This practice is being continued in another mine, a member of the same group, and the results confirm those obtained originally. In effect, stope faces are often advanced twice as fast as formerly, and, as a smaller number of stopes suffices to provide a larger tonnage, an increased reserve of available stope faces can be worked subsequently. The rapid advance of stope faces is important in some mining conditions where it is essential to remove a block of payable ore expeditiously.

The future for the gold mining industry, and so for the Union of South Africa, looks bright indeed.

DIAMOND MINING — Though the Premier mine in the Transvaal has not been producing for some years, because of the lack of demand for the class of diamonds it yields, two of the three mines at Kimberley have been producing steadily. Production there has been so regulated that the effect of slumps on the diamond market will be minimized in the future.

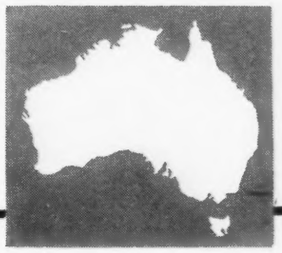
Silver mining, as such, has been in abeyance for some years. Silver however, is obtained as a byproduct of the gold-mining industry, whose gold is refined on the Witwatersrand. In 1937, 1,100,641 fine ounces were won, valued at £100,482; in 1938, 1,131,708 oz. were valued at £99,598.

Of copper 13,966 tons was sold for £606,314 in 1937; the corresponding figures for 1938 were 14,771 tons and £463,805. The purchase price for 942 tons of tin in 1937 was £117,249; and 1,142 tons were produced in 1938 of an estimated value of £95,473. Like silver, osmiridium is a byproduct in gold refining. The value of the amount recovered in 1937 was £37,254 for 5,667 oz. and £34,110 for 5,233 oz. in 1938. The Transvaal produced 30,125 oz. of platinum in 1937, valued at £237,663, and 38,862 oz. valued at £223,776 in 1938. Production should increase because of the recent advance in price.

I wish to express my indebtedness to the Transvaal Chamber of Mines and to the Government Mining Engineer for permission to reproduce statistical information.

AUSTRALIA

Gold production curve still upward, though showing tendency to flatten. New activity in old fields marked in Queensland. Base metals as usual



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MAINTENANCE of operations by existing producers, rather than the development and bringing into production of new mines, characterized Australian gold mining during 1939. Consequently, the curve of Australian gold production, though still rising, shows a tendency to flatten, and it is likely that the year's output will be in the vicinity of 1,650,000 fine ounces, about 60,000 more than last year. It is probable that the present price, £9-16-6 per ounce in Australian currency, after deducting Government excise duty, will, if maintained, have a stimulating effect on the search for gold.

With a larger proportion of Australia's gold coming from low-grade properties, the average assay of the ore treated continued to fall, although it is doubtful if established producers have, on the whole, appreciated to the full the advantages that might be derived from a policy of increasing tonnage and decreasing grade in these days of enhanced gold price.

WESTERN AUSTRALIA — No new mines of importance started operations in 1939, although there were increases in plant capacity at several of the already producing mines. Lake View and Star, Ltd., at Kalgoorlie, Australia's largest gold mine, installed additional plant, raising its output to about 60,000 short tons of ore monthly, and plans to erect a second tailings re-treatment plant of 60,000 tons' monthly capacity (about the same as that of the present re-treatment plant) to treat the Chaffers dump at the south end of the Golden Mile.

During the year, interest quickened in that part of the Kalgoorlie field which lies between the north end of the Mile, and the Hannans North mine, operated by the Broken Hill Proprietary Company, and several leases were taken under option. A diamond-drilling campaign is now in progress. The company principally interested in this section is Gold Mines of Kalgoorlie, Ltd., which in addition has also developed a large tonnage of low-grade but cheaply workable ore in its mines further south, and has just completed a 50 per cent increase in plant capacity, to 12,000 long tons monthly. Great Boulder Proprietary continued to increase its tonnage, and is now handling nearly 40,000 short tons monthly, compared with only about half that figure a couple of years ago. North Kalgurli (1912), Ltd., is developing solidly. Ore reserves are in excess of 780,000 long tons, or six years' mill supply at present rates. The company is to erect a treatment plant of about 7,000 tons' monthly capacity on its Croesus lease, in which a substantial tonnage of ore has been developed; this will be in addition to the 11,000 tons monthly at present treated at the mill of Kalgurli Ore Treatment Company.

Outside Kalgoorlie, the Norseman field has attracted attention, principally owing to phenomenal yields from the small but rich Blue Bird mine. The two principal mines in the field, Norseman Gold Mines, N.L., and Central Norseman Gold Corporation, N.L., are both expanding output. Big Bell, in the Cue district, was in steady production throughout the year, and is now treating nearly 40,000 short tons monthly, the yield averaging 2.75 dwt. (at present 27s. Australian) per ton. Costs have not been disclosed, but are believed to be not more than half this figure. Wiluna Gold Mines, Ltd., at Wiluna, has had comparatively little success in the location of new orebodies, although there have been some encouraging developments in the north-

ern part of the leases. A noteworthy occurrence here was the abandonment of the smelting process for the recovery of the gold from the flotation concentrates. Although metallurgically sound, it could not compete economically with a controlled-temperature roasting process, with subsequent cyanidation of the calcine, that was developed from a similar process practiced at Lake View and Star, Ltd. Incidentally, there was much research into roasting practice in Western Australia during the year. It has been found that roasting conditions, principally temperature, can greatly affect the subsequent cyanidation results, and recoveries are being appreciably improved as a result of better roasting practice.

VICTORIA—In Victoria, the outlook is still for greater recovery of gold by alluvial methods, principally dredging, than by lode mining. In the dredging field, the outstanding event of the year has been the performance of the Victoria Gold Dredging Company at Newstead, where 200,000 cu.yd. monthly is being turned over for a yield averaging over 4 grains per cubic yard. The company has already in less than eighteen months' operation paid £50,000 in dividends, or nearly half its paid-up capital. Of technical interest has been the success of the resoiling operations and the prevention of stream pollution. What will be one of the largest dredges in the world is in course of erection at Harrietville, near Bright, for Harrietville (Tronoh), Ltd. This dredge, of 350,000-cu.-yd. monthly capacity and carrying 20 cu.ft. buckets, will dig to a depth of 130 ft. The area contains 95,000,000 cu.yd. of wash averaging 1.9 grains per cubic yard.

Operations on the Bendigo field showed a steady expansion over those of last year, and several new discoveries of ore were made, notably on the Deborah anticline. Several of the mines increased mill capacity, and the general outlook is favorable. At Chewton, although prospecting is still active, Wattle Gully continues to be the only producer of any size. The company has recently increased its mill capacity to 2,500 tons per month. Grade is 7 dwt. and costs are met by 2½ dwt.

NEW SOUTH WALES—First year of operation of Wellington Alluvials, Ltd., operating a 250,000 cu.yd. dredge on the Macquarie River, New South Wales, revealed unexpected difficulties. The ground proved much harder to dig than the testing work had indicated, with the result that the bucket band became unequal to its task and had to be replaced. The dredge is now working satisfactorily and costs have been reduced. New Occidental Gold Mines, N.L., at Cobar, continued to develop the New Occidental and New Cobar mines with satisfactory results, and is now unwatering the old Chesney mine. About 12,000 tons of ore is being treated per month, producing 3,000 oz. of gold as bullion, together with 1,500 oz. of gold and 50 tons of copper monthly in the form of flotation concentrates.

AUSTRALIA

NEW GUINEA—Bulolo Gold Dredging, Ltd., continues to supply the major part of the gold output of New Guinea, and has now eight dredges at work with a total capacity of 1,665,000 cu.yd. monthly. With the exception of No. 6, which has 5¾-cu.ft. buckets, the dredges are equipped with from 10½- to 11-cu.ft. buckets. Digging depths range from 27 to 90 ft. The average output of gold is 15,000 oz. monthly. Dredgeable gravel reserves at May 31 last were 182,000,000 cu.yd., enough to last a little over eight years at the present rate. In addition, the company holds 20,000,000 cu.yd. of ground which will be worked by hydraulicking. New Guinea Gold Fields, Ltd., is working the Edie Creek and Golden Ridges mines at the rate of 6,500 tons monthly of 8 to 9-dwt. ore, and also holds sluicing properties which are just beginning to bring in a good return. Enterprise of New Guinea has a reserve of 285,000 tons of 7-dwt. ore in its Edie mine, but does not intend to proceed with plant erection until the road from the coast (preliminary work for which is now in progress) is completed.

Cuthberts Misima Gold Mine, Ltd., Misima Island, is now milling at the rate of 3,500 tons monthly of 6-dwt. ore. Reserves total over 300,000 tons, with much ground yet to be prospected.

QUEENSLAND—The scale of operations at the Mount Morgan mine has increased, and a total of 75,000 long tons monthly is now treated. Of this, 45,000 tons consists of so-called "sulphide" ore, but the mill in addition to sulphidic material also takes considerable oxidized and altered material, the copper content of which is too great for cyanidation. Average head assay of the material treated is 3.3 dwt. gold and 0.7 per cent copper. The flotation concentrate, previously shipped to the United States for realization, is now smelted to blister copper at the mine. The "oxide" mill treats 30,000 tons monthly of low-grade oxidized auriferous material, assaying 1.5 dwt. per ton, by cyanidation, and also retreats the greater part of the sulphide mill tailings, which carry 0.5 dwt. per ton of cyanide soluble gold. Total output for the year to June 30, 1939, was 73,742 oz. of gold and 2,975 tons of copper, 869,250 tons of ore being treated. Sulphide ore reserves are estimated at 6,993,000 tons assaying 4.2 dwt. gold and 1.8 per cent copper. There is in addition a large but undetermined tonnage of oxidized ore.

At the Golden Plateau mine, at Cracow, the other main Queensland gold producer, 7,000 tons of 5.5 dwt. ore is being milled monthly. Developments at depth have shown improvement lately, after having been poor for some time. The cost of producing gold is 80s. Australian currency per ounce, possibly a lower per-ounce cost than any other Australian lode-gold producer.

There has been considerable activity in Queensland during the past year in the reopening of old gold fields, mainly by small parties and syndicates, which are finding it profitable to mine ore which was unpayable at the old standard price. Such activity is not confined to Queensland, but is perhaps most marked in that State.

Gold mining continues on a small scale in Central and North Australia, but still suffers from the handicaps of inaccessibility and the lack of an assured water supply.

BASE METALS—The principal feature in the lead-zinc field was the reequipment of the North and Zinc Corporation mines, at Broken Hill, with new mills. That at the North mine, using jigs, tables, and flotation, was designed for a output of 600,000 long tons of ore annually, but has been found capable of handling 15,000 tons weekly, or 750,000 tons per annum. The Zinc Corporation plant, which employs the all-flotation process with a simple flowsheet, has a nominal capacity of 500,000 tons yearly, but could probably exceed this. Developments at depth give promise of a long life to the north and south ends of the field, but the B.H.P. and Sulphide Corporation mines in the central section are nearly exhausted. The former has already closed down. The South mine, next to the Zinc Corporation, has, so far as known, a life of ten years. This company is noted for its milling work, which is of a high standard. Lake George Mines, Ltd., began operations at Captain's Flat, New South Wales, but is not yet earning profits. The ore has proved difficult to treat, and rated capacity of 500 tons daily has not yet been reached. Mount Isa has made additions to plant and is now treating about 15,000 tons of ore weekly. Although a small profit was made last year, no provision has yet been made for depreciation of plant, and the mine obviously requires higher metal prices. Operation of the Electrolytic

Zinc Company's mines at Rosebery and Williamsford, Tasmania, continued at the rate of 150,000 tons annually. Ore reserves were maintained at 1,500,000 tons.

Mount Lyell, which for some years has been increasing its ore treatment rate rapidly, with concomitant decrease in the grade of ore, treated 1,085,933 long tons during the year and produced 13,393 tons of copper. Costs for the year to Sept. 30 totaled £53 6s. 6d. Australian currency per ton of copper, and are likely to rise, so that the maintenance of at least the present price of copper is necessary to the continuance of profitable operations. Outside of Mount Lyell, Australia's copper production is only about 6,000 tons annually, mainly from Queensland, and this is produced at a relatively high cost also. The rapidly increasing domestic demand is absorbing all the copper produced in the country, but with a higher price both the Tasmanian and Queensland fields could increase production.

Tin production is now at the rate of a little over 3,000 long tons annually, this being divided among a large number of small producers in Tasmania, Victoria, New South Wales, and Queensland. The first unit of Tableland Tin Dredging, Mount Garnet, Queensland, a reconstructed dredge of 80,000 cu.yd. monthly capacity, came into operation during the year.

Under the stimulus of improving prices, production of tungsten concentrates has increased. The principal fields are in Tasmania, where wolfram is produced at Storey's Creek and Aberfoyle, at both places as a byproduct of tin mining on Kings Island (scheelite); in central Australia, where the Hatches Creek and Wauchope deposits yield wolfram; and in Queensland. Total production amounts to about 800 tons of wolfram concentrates and 250 tons of scheelite concentrates annually. Western Australia is the principal producer of tantalite, with a smaller output from North Australia. The total production of about 15 tons annually constitutes an important proportion of world tonnage.

The search for oil is maintained, so far without commercial success. Drilling on the Australian mainland is in progress at Lakes Entrance, Victoria (where a small production has been developed), at Roma, Queensland, and in the Kimberley district of Western Australia. In Papua, Australasian Petroleum, a subsidiary of the Vacuum and Anglo-Iranian companies, has been conducting an extensive survey, and intends to start drilling shortly, while Papuan Apinaipi, a Melbourne-controlled company, after getting widespread shows of oil and gas in the Oiapu area, is about to commence deep drilling.

THE PHILIPPINES

Output of gold 15 per cent greater than in 1938, with 15 new producers. Base metals also show increase. New taxes hit larger mines. Government cooperation

RALPH KEELER
Manila, P. I.

CONTINUED INCREASE in gold and base-metal production featured the Philippine mining industry during 1939. Estimates for the year, based on figures for eleven months, indicate that the total gold output will be nearly 74,000,000 pesos, an increase of 10,000,000 pesos over the 1938 figure. Dividends paid from 1939 operations amount to around 24,500,000 pesos—over 11 per cent higher than in 1938.

Base-metal production for eleven months was 1,250,081 tons, valued at 8,213,832 pesos, compared to 1,116,080 tons, valued at 6,445,660 pesos, for the whole year 1938. Nearly 84 per cent of the total was iron ore, all of which went to Japan. A slight increase in the tonnage of chromite and copper ores shipped was reported, but manganese exports fell off somewhat. The single lead-zinc operation in the Islands, which produced a small amount of concentrate in 1938, closed down in 1939 because of low prices and lack of ore.

The two large base-metal orebodies in the Philippines, iron at Surigao and chromite at Masinloc, in Zambales, are still potentially important but have not been worked yet to any extent. At Surigao the Government has completed its development. Negotiations for the sale to Japan of the 750,000,000 tons of ore reported were carried on but fell through because suitable contracts could not be arranged—the main difficulty being the inability of Japan to guarantee cash payment. Interest in the Masinloc chromite deposit, being worked by Benguet Consolidated, was stimulated with the outbreak of war. However, this ore is of too low grade to be of interest to the United States for use in building stockpiles of strategic minerals. The sales made were practically all for refractory purposes.

Fifteen new gold mines went into operation, most of them supplying small mills, the largest of which is that of North Camarines Gold, in the Paracale district, which started a 350-ton-per-day cyanidation-flotation operation in March, to handle ore from its own mine and from Mambulao Consolidated, Paracale National, and the Guy Willey group in the same area. The four mines are Soriano-operated. Mine Operations, which operates the Capsay mine, on the island of Masbate, also began milling in March, with a 100-ton cyanide plant. Early in the year a 100-ton plant using the Vandercook cyanide process was started at the Treasure Island mine, in Camarines Sur, under the operation of Pan Philippine Corporation. Kilometer 73 Mining Company started a 75-ton flotation plant at its Lacandola mine, in Surigao, in July. The Marsman interests completed a 50-ton cyanide plant at the Tuba mine of Northern Mining & Development Company in the Paracale district in February. Paracale Mining & Development's 100-ton cyanide plant went into operation in January in the Paracale district. In the same area, ore from the Santa Ana-San Joaquin mine is being milled at the Tumbaga cyanide plant of Consolidated Mines. In May the Tapi-an Surigao Gold Mine, Inc., started a 100-ton cyanide plant in the Surigao district. Santa Cecilia Mining Company is operating a small placer mine in Oriental Misamis, and the Mayon Mining Company a 50-ton flotation-amalgamation plant at Labo, Camarines Norte. In the Baguio district ore from the Benguet Goldfields and Crown Mines' properties is being treated at the Demonstration mill, both mines coming into production late in the year.

Output from these new producers was responsible to a great extent for

Table I—Philippine Gold Production

Mine	1939 (Estimated) Pesos	1938 Pesos
Ambassador	.....	78,034.18
Antamok Goldfields, *s*	3,151,000	4,724,698.41
Baguio Gold	1,843,000	1,727,388.88
Balatoc, *b*	12,429,000	12,783,210.12
Benguet Consolidated, *b*	11,425,000	11,262,195.22
Benguet Exploration	10,000	253,132.84
Benguet Goldfields	110,000	.....
Big Wedge	1,905,000	1,940,542.70
Cal Horr, *b*	1,425,000	1,237,045.71
Capsay	1,231,000	.....
Coco Grove, *m*, *p*	2,192,000	2,212,291.78
Crown Mines	80,000	none
Demonstration	1,150,000	1,796,296.20
East Mindanao	675,000	581,413.16
Gold Creek	120,000	.....
Ipo Gold, *b*	1,290,000	998,330.42
Itogon, *m*	4,625,000	4,085,112.79
I. X. L., *s*	3,075,000	3,096,785.05
Km. 73	510,000	.....
Macawiwili	400,000	.....
Mapaso	27,000	.....
Mambulao Consolidated, *s*	340,000	.....
Masbate Consolidated, *s*	5,000,000	4,158,969.08
Masbate Goldfields	250,000	56,359.44
Mindanao Mining	125,000	66,641.00
Mindanao Mother Lode	1,435,000	1,462,526.54
Mineral Resources	130,000	.....
North Camarines, *s*	1,865,000	.....
North Mindanao, *p*	110,000	121,622.80
Northern Mines	495,000	.....
Paracale Gumaus	1,130,000	381,208.75
Paracale Mining	120,000	.....
Paracale National	180,000	.....
Royal Paracale, *m*	265,000	232,486.81
San Mauricio, *m*	6,515,000	4,022,734.43
Sta. Ana Sn. Joaquin	67,000	.....
Santa Rosa	951,000	881,649.69
Surigao Consolidated	1,285,000	607,138.79
Suyoc Consolidated, *m*	1,631,000	1,674,610.55
Tambis Gold, *p*	100,000	248,794.00
Tapi-an Surigao	60,000	.....
Tinago	70,000	50,861.20
Treasure Island	550,000	.....
Twin Rivers, *t*	254,000	334,613.24
United Paracale, *m*	2,920,000	2,625,399.19
Totals	73,521,000	64,066,165.32

p, Placer operation. *t*, Tailings plant. *b*, Operated by Benguet Consolidated interests. *m*, Operated by Marsman interests. *s*, Operated by Soriano interests.

the new yearly record. Of the older producers, San Mauricio, which increased its production 50 per cent to more than 6,500,000 pesos, and Surigao Consolidated, which accounted for 1,270,000 pesos in gold, nearly double the 1938 figure, were outstanding, there being but little change in the performance of the others.

The new tax law provides a tax of 1½ per cent straight on the gross production of base metals. Gold lode mines are taxed on a sliding scale from 1½ per cent on gross production up to 500,000 pesos per year, then progressively up to 8¾ per cent on gross productions of 12,000,000 to 14,000,000 pesos. Deductions are 15 per cent from the tax on gold lode mines averaging 7 to 10 pesos per ton and 30 per cent on gold lode mines averaging less than 7 pesos per ton. Placer mines are subject to a deduction of 25 per cent on any grade. Proposed new tax rates would hit the larger mines, notably Benguet and Balatoc, heavily, but would not affect the smaller operations appreciably.

In general the Government has shown a more cooperative attitude toward the industry. The Bureau of Mines, under the supervision of Dr. H. Foster Bain, advisor on mining to President Quezon, and Quirico A. Abadilla, director, has completed geological surveys of several parts of the Islands, and is engaged in others.

The labor situation is quiescent. A certain unrest among the laborers in the Philippines exists, caused, perhaps, to a great extent by the broad "social justice" program announced by the Commonwealth administration. The mine workers are better paid and better treated than in any other industry by far, yet there have been several strikes caused by professional agitators, all of which were settled amicably.

In anticipation of the war most of the mining companies laid in heavy stocks of supplies and equipment, most of them six months in advance of ordinary requirements. Higher prices for supplies will undoubtedly lower profits during 1940, but should not affect the industry appreciably.

Development work in the larger and older mines has by no means determined an end of the orebodies being worked. Ore reserves of most of the companies are keeping up with production, the general policy being to have two years' ore blocked out in advance.

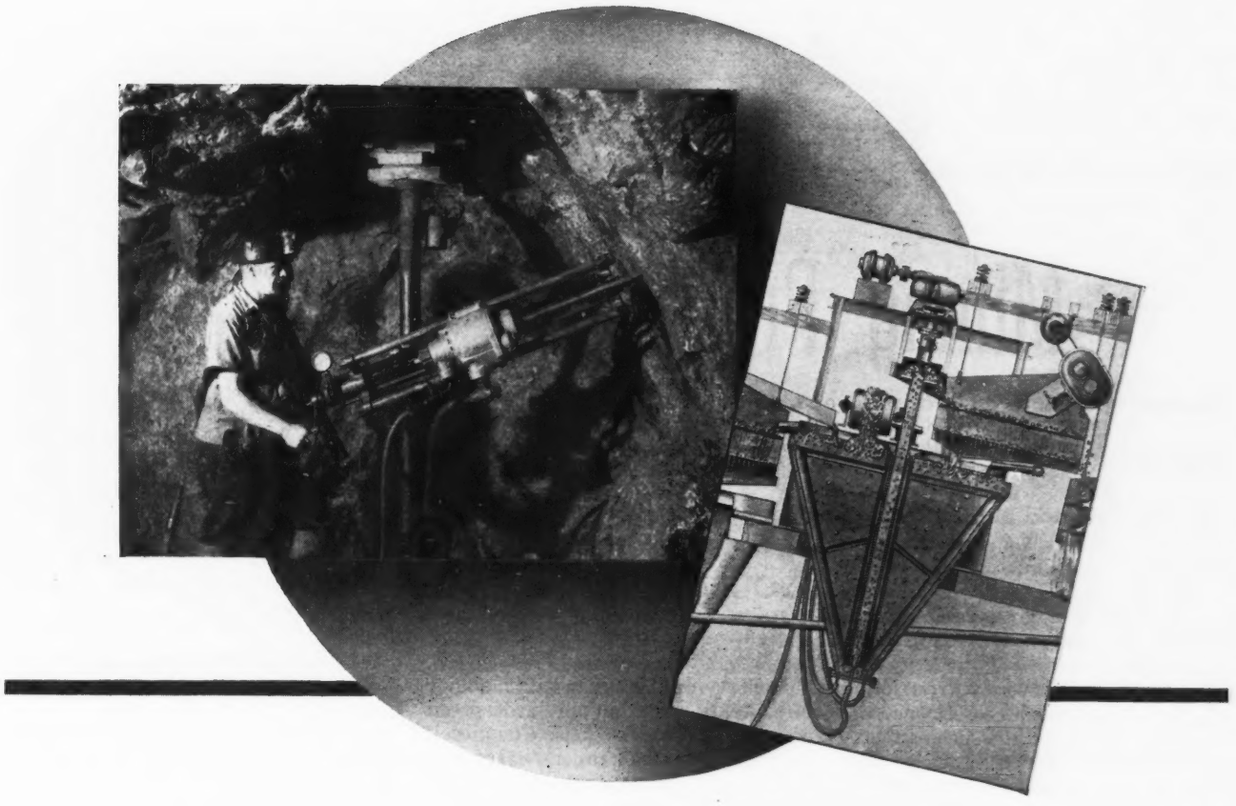
Table II—Dividends Paid by Philippine Mining Companies

	1939		1938	
	Per Share, Pesos	Total Amount, Pesos	Per Share, Pesos	Total Amount, Pesos
Antamok	0.035	962,500	0.075	2,062,500
Atok, *a*	0.06	600,000	0.04	400,000
Baguio Gold	0.02	259,980	0.025	324,975
Balatoc	0.80	4,800,000	1.10	6,600,000
Benguet Consolidated	0.85	10,200,000	0.70	8,400,000
Big Wedge	0.04	311,077	0.04	311,077
Coco Grove	0.02	300,000	0.02	300,000
Demonstration	None	.....	0.04	400,000
East Mindanao, *b*	0.01	100,000	None	.....
Eastern Development Co., *a*	0.001 (*d*)	111,500	(*e*)	(*e*)
Hixbar	0.04	819,568	None	.....
Ipo	0.025	224,950	0.016	129,967
Itogon	0.04	1,000,000	None	.....
I. X. L.	0.09	1,350,000	0.08	1,200,000
Lepanto	0.005	52,500	None	.....
Marsman, Common, *a*	0.08	150,448	5.00 (*c*)	940,300
Marsman, Preferred, *a*	0.08	150,448		
Nielson	0.005	75,000	None	.....
Peracale Gumaus	0.005	25,000	None	.....
Phil. Iron, common	10.00	400,000	17.50	700,000
Phil. Iron, preferred	0.80	19,567	0.80	24,420
San Mauricio	0.135	2,700,000	0.02372	477,500
Surigao Consolidated	0.01	102,297	None	.....
Suyoc Consolidated	0.01	125,000	0.02	250,000
Tambis	None	.....	0.005	19,679
United Paracale	0.04	520,000	0.042	551,176
Totals		24,759,835		23,091,594

(*a*) Mine management companies; (*b*) Estimated by us; (*c*) Dividend on the old no-par value shares; (*d*) Also 1 share of Mambulao Cons. and 1 share Paracale National for each 100 shares Eastern Development; (*e*) Paid 2 shares Mambulao Cons. for each 100 shares Eastern Development.

Table III—Base Metal Production in 1938 and 1939

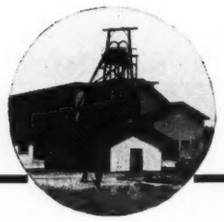
	1938		1939 (11 months)	
	Tons	Value, Pesos	Tons	Value, Pesos
Iron				
Philippine Iron Mines	776,409	3,493,715	644,051	2,866,022
Samar Mining Company	118,919	505,405	246,280	1,102,600
Gold Star Mining Co	17,077	72,577	89,812	384,376
Agusan	.....	.....	69,654	376,443
	912,405	4,071,697	1,049,797	4,729,441
Chromite				
Acoje Mining Co	14,844	326,583	1,000	25,000
Florannie	13,870	398,373	7,150	143,000
Consolidated Mines	10,070	49,374	19,500	197,000
Zambales Chromite	.....	.....	15,842	340,064
Tagobomar	1,008	16,820	.....	.....
	39,792	791,150	43,492	705,064
Copper				
Lepanto Consolidated	119,521	990,510	123,782	1,648,814
Hixbar	2,159	80,465	21,894	860,743
Philippine Copper	800	8,927	.....	.....
	122,480	1,079,902	145,676	2,509,557
Manganese				
Philippine Nippon	4,130	112,290	6,389	161,850
Cia. Minera	2,107	42,140	1,096	21,920
Grawfus Manganese	6,799	112,502	.....	.....
Amalgamated Minerals	.....	.....	3,631	86,000
Philippine Manganese	575	9,200	.....	.....
	13,611	276,132	11,116	269,770
Lead-Zinc				
Mineral Resources	27,791	226,778	.....	.....



The Operating Trend

ONCE AGAIN the twelve months have run their length, and those who summarize the year's developments in mining, milling, and metallurgical practice have done their work. The results of their labors are presented in the following pages for the benefit of all who find such summaries useful. Time-saving they surely are, and likewise fairly comprehensive—too comprehensive if anything, in that every reviewer normally finds the period too short and tends to spread out over a longer one, so that his reviews for successive years are likely to overlap. If a fault, this at least is helpful.

Described at some length by one reviewer and also dealt with elsewhere, this fact denoting it justly as an outstanding piece of technological news of the year, is the process of sink-and-float or heavy-medium separation (call it what one may prefer with respect to accurate definition) applied to the zinc ores of eastern Tennessee and the Tri-State district, and in a different way to iron-ore beneficiation on the Mesabi Range. Large tonnages have already been treated in the three plants built. Underground, a noteworthy development that is growing in importance is the use of the diamond drill for boring blast holes. Both trends are suggested in the illustrations on this page.



Mining Practice

Current operations in dredging, open pits, and underground show interesting trends. Drilling and ground-breaking technique foreshadow new and important developments in this direction

GEORGE J. YOUNG
Consulting Editor

TAXES and severely restrictive laws have combined to narrow operating margins to such an extent as to cause mining staffs to take advantage of expedients, newer methods, and new equipment wherever possible. New ideas do not burst upon the mining industry overnight. Improvements develop over a considerable period, beginning with innovation at some mine, adoption at another, publicity by description, and then they advance into mining practice to be tried and rejected by some and to yield benefits to others. Improvements are being made by manufacturers in the standard mining tools and equipment from time to time. Now and then some new piece of equipment is offered and, if successful, it may cause fundamental changes in methods.

PROSPECTING—R. A. Grimes [1] describes the successful use of a 60-hp. diesel tractor, equipped with bulldozing blade, for prospecting an area covered by surface drift at Sandon, B. C. The over-all cost in this instance was estimated to be 10c. per cubic yard of rock and earth moved. In general, there has been an increased use of diamond drilling and geophysical examination in prospecting. Night prospecting of suspected outcrops for tungsten minerals by the aid of ultra-violet portable lamps is of interest.

ALLUVIAL MINING—Great attention is being given to alluvial gold mining and to improvements in practice. Many draglines, greatly improved mechanically and operated by diesel engines, are being used in conjunction with pontoon-mounted washing plants for working areas too small and too shallow to be dredged. The portability of the rig and its mobility in operation encourage widespread use of it in placer regions. The diesel-tractor bulldozer, scrapers, carry-alls, auto-trucks, and super-rooters are employed in stripping as a preliminary to dragline-excavator, dredging, hydraulicking, and ground-sluicing operations. Diesel-operated pumps supply water for sluicing, hydraulicking, and ponds. Mobile dry-land washing plants have been still further developed and are now mounted upon caterpillar treads and moved by tractors. In Alaska steel-trestle sluices that can be moved about are being used in conjunction with bulldozers. The combination is said to work under a variety of conditions.

In gold dredging, deeper digging in unusually heavy ground is made possible by the Perry idler, which takes up part of the weight of the bucket catenary and keeps it off the bottom of the pond; also by the Yuba mud pump, which removes accumulations of sand and mud about the lower end of the digging ladder. For handling tight, semi-cemented gravels, a line of smaller buckets is substituted for the larger ones, with improved digging. Slower bucket-line speeds, with lower capacities, have improved the efficiency of gold saving on some dredges. New bucket lips, attached by a few bolts, have speeded up relipping, which can now be done with the bucket line in place. Greater head area of tables and better distribution of sands have increased gold saving. Molded rubber riffles, or wooden riffles protected by rubber strips, in place of the Hungarian riffle with its steel strip on wood, have proved to be an improvement. The use of rubber lining for all sluices is now standard. Alloy steels continue to find greater application on the gold dredge and the use of rubber has been practically doubled. For free-gold gravels, the use of modern riffled tables, in conjunction with amalgamation, is standard, but where gold cannot be amalgamated or is associated with heavy minerals, jigs find successful application. In recently installed dredges changes have been made in main drives. On Yuba 20, motors are in pairs, one on each side of the upper tumbler (300 hp. 580 r.p.m.) with V-belts between pulley and the two gear trains operating the bull gears. Motors are sufficiently synchronized to avoid differential lagging. Winch and screen units are V-belt driven. Separate or independent ladder hoists are now used. P. Malozemoff [2] describes methods for continuous sampling of dredge sluice discharges. Measurement is made by flow tests or by calculation. Accurate control by some means of sampling would be of value and results may come from Malozemoff's work.

OPEN-PIT MINING—In small open pits or quarries, the small full-revolving, caterpillar-tread power shovel (diesel, gas, or electric) is standard for loading and the diesel or gasoline truck for transportation. Stripping is by bulldozer and scraper or by carry-all and tractor. With greater depths of overburden and longer distances, the power shovel and truck may be used. For drilling, portable compressor units (diesel-operated or gas) and tripod-mounted or hand-held drills are employed. In some pits conveyor systems have been tried, with trucks serving the power shovels and delivering the ore to a crusher and the conveyor system.

Railroad haulage is yielding in places to truck haulage, which is more mobile and which permits relatively steep pit-entrance grades. The availability of large powerful trucks has in cases changed pit-entrance design materially. The Clay orebody of the Phelps Dodge Corporation is being stripped in 50-ft. benches by 4½-cu.yd. electric shovels loading into 22½-cu.yd. trucks. Electric churn drills, equipped with 9-in. bits, drill holes for primary blasting; jackhammers (with detachable bits) are used for other drilling; for general road and surface work 1-cu.yd. diesel-driven shovels, 5-cu.yd. trucks, and diesel-powered tractors equipped with hydraulic bulldozers and towing winches are used. Pit-road grades are maintained at 6 to 7 per cent. After the pit has been partly stripped it is planned to use a track system and to employ diesel-electric locomotives.

ROCK DRILLING—In large open-pit operations the electric churn drill (caterpillar-mounted) employing 9-in. bits with wider spacing of holes and

larger charges of explosive has been installed in several instances. At the Frood open pit in hard rock, bits of nickel-chromium-molybdenum steel, 9 in. in diameter, have given better service than those of high-carbon steel previously used.

Use of detachable bits continues to spread. Hot-milling, grinding, and other sharpening appliances, as well as the use of better and better steels, are making many changes in drilling practice. Lucien Eaton[3] points out that more accurate control over drill-bit forming and sharpening, resulting from hot-milling and grinding machines, has made possible improvements in rock-drilling technic. He advocates a nearer approach to cylindrical reaming surface in the double-taper bit. W. M. Ross[4] estimates that about one-quarter of mine rock drilling is done with replaceable bits. A. G. Pugsley and W. G. Brissenden[5] describe some Canadian experience in reforging detachable bits and the use of one of a dove-tailed type. Gage changes are 1/16 in. Drill hole costs were 1½c. per foot with detachable bits and 15.3c. per foot with standard steel. A number of Canadian mines are using detachable bits of several different local types. In the aggregate, considerable research is being done on rock drills. By way of interest, one company in California is making and using replaceable bits on hand steel used in prospecting.

BORING—O. J. Parker[6] describes an interesting method of sampling a gold deposit by the use of a diamond-drilling machine and auger-type bits, tipped with cast iron. Most of the holes were at an elevation of 82 deg., averaged 110 ft. in length, and were drilled dry, the sample cuttings being caught in a canvas funnel connecting with a metal funnel to which the sample bag was attached. The ore was oxidized and relatively soft. Sampling by other methods failed to give consistent results. Drill speed was 17 ft. per drill shift and costs were 6c. per foot. At Kimberly, Nev., nine holes have been completed with a rotary drilling rig in sampling and prospecting work to attain depths up to 1,500 ft. Cores have been successfully removed from the ore zone. G. Austin Schroter[7] describes the use of the cup-auger in prospecting and sampling deposits of bleaching clays.

DIAMOND DRILLING — Comparatively widespread use is being made of the diamond-core drill in prospecting and exploration work. Bortz, a better and lower-cost bit, and its availability at a number of supply points have displaced to a considerable extent the hand-setting of diamond bits at the site of the drilling. So far, two different types of core bits have come to my attention: one is the Kocbelite, made by the use of inserts of cast metal, containing the bortz crystals, brazed to exact gage in an abrasive-resistant alloy steel bit blank; the other, the "Processed" bit and the Diamond Tool Company bit, is made up of an alloy containing the bortz crystals in exact position and formed under pressure and heat from powdered metals at a temperature not exceeding 1,350 deg. F. In both bits a comparatively large number of stones, from 60 to 140 in an EX bit, are set accurately. The stones are firmly held and the bits give excellent service. The use of a greater number of cutting points and a cheaper stone has resulted in faster cutting and lower all-round costs, especially cost of diamond wear. Drill speeds have been increased. Drill-rod speeds range from 600 to above 1,200 r.p.m. Lighter weight and better made drills are becoming available. A manufacturer has placed on the market a column-mounted diamond drill, weighing 230 lb., and driven by an air motor of the vane type, for all-round service underground and high-speed drilling. Various forms of bits are being experimented with and the whole situation in diamond drilling has been shaken up over the possibilities of diamond drilling for blast holes.

Diamond-drill holes have been used now and then in the past for blasting purposes in the iron and copper ranges of Michigan, by W. I. Nelson at the Engels mine in pillar mining in shrinkage stoping, and at other mines, but such work was looked upon as a special application that had no great bearing upon ordinary mining work. However, at the Noranda mine, deep drill holes (up to 60 ft.), drilled by means of sectional steel and steel bits as well as by diamond drills, have proved especially advantageous in ground breaking in the sublevel method of stoping. This use has stimulated experimentation in perfecting simpler methods for diamond drilling and lighter and handier machines for underground use in such stoping. It has also revived ideas about a more extensive use of the diamond drill in ground breaking by blasting long holes. It is quite possible that a new drilling and ground-breaking technic will develop from the Noranda work.

EXPLOSIVES — E. M. Sauve describes current practices in storage, transportation, distribution, and use of explosives in the Butte mines. It is interesting to note that the notched spitting-fuse is still used for group blasting where fuse is used. In this connection the Ensign-Bickford "master fuse-lighter" is also of interest. It consists of a waterproofed fiber shell, topped with a flexible rubber cover. Each fuse, after trimming, is thrust through the rubber cap until in contact with the ignition compound in the base of the shell. A pilot fuse is also inserted with the other fuses and is ignited in the usual way. The shell accommodates six fuses together with the pilot fuse. The same company also advertises a "pull-wire fuse lighter" for single fuse lighting. Electrical blasting now occupies a more widespread field in everyday mining operations. The use of stemming has increased. Discussion about materials for stemming and their use is active.

H. C. Henrie states that the "burn-cut round" is used largely in the Copper Queen mines. More or less attention is being given to methods that will secure a maximum depth of round such that synchronization with mechanical loading may be better. Use of the "burn cut" began in water development tunnels of large section and has spread into mining practice. By its use the number of cycles for a given length may be greatly reduced, with a corresponding reduction in the loader cycles. R. O. Camozzi[9] gave details of "burn cut" rounds at the Zeibright mine several years ago. R. H. MacWilliam and R. J. Goode[10] describe the development of the "drag round" in certain mines of South Africa. This is a round laid out symmetrically about the vertical center line to break a central wedge in the face with the initial sequence of blasting holes breaking out the toe at the center and other holes slabbing to the central wedge in sequence. Depth of round is 8 to 9 ft. in a 9x8-ft. heading.

LOADING—Development of scraper loading in the Tri-State district is described at length by S. S. Clarke.[11] The machine finally developed consists of a slide, caterpillar-mounted, three-drum winch for operating the scraper and with electric motors for power. A book by the engineering staff of the Ingersoll-Rand company gives an excellent summary of scraper rigs for underground operation, together with their application to various methods of mining. In development work the mechanical loader is being widely used.

SHAFT SINKING—In shaft mucking no significant improvements are to be noted. Descriptions of several notable shafts of recent construction have appeared. R. Daniel and J. G. Lawn discuss the circular ventilation shaft of the new State Areas, Ltd., South Africa. This shaft is 2,754 ft. in depth with no obstruction from top to bottom, the top 800 ft. being lined with smooth concrete, 20 ft. internal diameter, and the lower section, 22 ft. in diameter, being unlined. The best sinking rate was 323 ft. in one month; average per month 300 ft. for six months. V. J. Southey[12] gives many details of Hol-

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linger's shaft practice, more especially two recent shafts, No. 25, an interior shaft, and No. 26, a new central hoisting shaft. No. 25 was sunk with steel blasting bulkhead (sinking frame); both raising and sinking were practiced. No. 26 shaft is rectangular with four skip compartments and one centrally placed compartment for manway and pipes. Skip compartments are 4 ft. 8 in. by 6 ft. 6 in. Steel guides are used. Skips are of 6-ton capacity and of standard steel construction; weight is 7,252 lb. In No. 25 shaft, stainless steel in cage construction replaced aluminum, which showed excessive corrosion. For skip hoisting preformed Lang-lay ropes are installed.

J. G. Ross and others[13] describe the King Mine No. 3 shaft of the Asbestos Corporation. A steel blasting bulkhead and steel sets were used throughout with wooden guides. Five compartments roughly approximate a square; two skip compartments on one side, a center cage compartment and manway, pipe and counterweight compartments on the other side. The cage is constructed of aluminum alloy, as are also the skips.

Installation of rock breakers underground in advance of shaft storage pockets with conveyors delivering to the shaft pockets continues to receive attention.

R. L. Rutherford[14] describes wireless signalling in shaft service, as does also G. N. Bjorge,[15] who gives a brief description of a "close-coupled radio system" for supplementary shaft signalling at the Homestake mine. L. C. Moore[16] describes a spherical-bottom skip of alloy steel construction which seems to have eliminated trouble with wet sticky ores. The 94-cu.ft. skip weighs 6,000 lb.

PUMPING—The single-lift pumping plant of the Magma mine is a noteworthy installation.[17] The details are given by E. E. Slack. Horizontal pumps of the Prescott-Menominee type have been installed to handle the 3,304-ft. head. The units are of 600-g.p.m. capacity.

STOPE FILLING—A. J. M. Ross[18] gives many details of the sand-filling practice at the Homestake mines. A 6-in. rubber-lined pipe is installed in the shaft with rubber-lined tee at each level. The shaft pipe receives the sand after it has passed through a dewaterer and a conditioner where the sand-water mixture is brought to 60 per cent solids. The sand stream is delivered to any one level by the insertion of dummy disks and rubber-covered disks. Metal pipe is used on the horizontal runs. Filling is usually delivered to the tops of the stopes, although some pressure filling has been tried at the bottom of the stope. Stope openings are bulkheaded and burlapped to prevent leakage of the sand. At Noranda a mixture of granulated slag and tailings to the amount of some 7,000 tons per day is being used for back-filling in worked-out stopes. The slag is delivered through raises to the empty stopes and the tailings are delivered through a drill hole into a rubber hose and discharged through a nozzle over the slag as it is charged into the stope. The pyrrhotite in the tailings acts in time to cement the fill together. Systematic back-filling of mined-out ground is an important method of control of ground movement and is significant of mining practice in all important districts where deep mining is in order.

MINING METHODS—Some interesting variations of the sublevel stoping method are given by E. V. Neelands and J. P. Millenbach[19] in the practice at the Canadian Malartic mine. Sublevel intervals are at 34 ft.; manway pillars divide the stopes. The lowest limits of the orebody was developed as hopper bottoms connecting with ore passes in the stope nearest to the shaft and these connect with the shaft storage pockets. Mining began at the lowest part of the orebody and production was quickly started while development was being extended laterally and above. Jay Tuttle[20] gives many details of the method of spiral stoping employed at the Beattie mine.

Further details of Noranda sublevel stoping practice are given by O. Hall, R. V. Porritt, and A. D. Carmichael.[21] Previous accounts have appeared. Noranda's mining practice is well worth considerable study by mining engineers, as the system of ring-drilling of long blasting holes by means of sectional steel or by the diamond drill is very suggestive. It is also worthy of remark that without the modern development of electrical blasting practice the Noranda method of stoping would be greatly modified.

In describing block caving at the Sunrise mine, G. H. Rupp[22] remarks that it has been found better to have a short interval between grizzly and haulage levels with a larger number of pony-set positions than to have long branching raises, as raises are harder to drive, to connect with the grizzly positions, and to maintain after the block takes weight. He states that it is more economical to develop a sublevel and transfer the ore to the main haulage level than to drive a series of raises in weak ground. These observations are in line with improvements made in block-caving practice in Nevada and Arizona. At the Ruth property of the Nevada Consolidated a system of parallel grizzly drifts connects by transfer raises to a single main-haulage drift serving a given block. Finger raises connect with the undercutting levels and serve as ore passes to the grizzly drifts. Stop boards are used to control ore flow at these ore passes. Ore is transferred horizontally along the grizzly drift by scraper, which discharges into the ore transfer to the haulzage level. Thus the network of branched raises serving numerous grizzlies in the grizzly drifts is avoided; main haulage drifts are reduced in number, and development costs are greatly reduced along with reduced development maintenance. At two other mines it is planned to try out shaking conveyors in the grizzly drift.

U. E. Brown and S. W. McDougall[23] state that mucking machines are used in the Bunker Hill mine on development headings and stope floors and that scrapers are used in some of the flat stopes for both ore removal and waste-rock distribution. G. Van Esbroeck and M. Van Wetenbergh[24] describe a modification of the inclined top-slicing method used at Kipushi, Katanga. The necessity for selective mining reduced the floor angle to 16 deg. Slices are 7 to 8 ft. in height and broken ore is moved to the chutes in iron-plate channels of semicircular section. C. R. Julian[25] brings up to date mining methods employed at the Rio Tinto mines.

DUST CONTROL—The use of the "thermal precipitator," originally devised by Whytlaw-Gray and Lomax, in sampling mine dusts, together with many significant results of such measurements, is given by H. S. Patterson.[26] The new method gives more accurate results than the konimeter. A more thorough knowledge of mine dusts and their toxicity is at hand.

DEPTH OF MINING—Deep mining, involving technical problems of temperature and humidity control, ventilation, ground support, hoisting and drainage to a greater degree than in mines of moderate depth, has made important advances and it is now possible to contemplate mining at depths of 9,000 to 10,000 ft.

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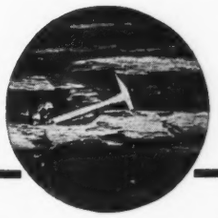

Mining Geology

Use of detailed structural mapping increases, as guides to ore finding are studied. Laboratory techniques show improvement in various directions. Advance in research and publication

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THE death of Waldemar Lindgren on Nov. 3, 1939, saddened all who knew him. He was unquestionably the leader in our field for several decades and to the day of his passing. His influence and example permeated and stimulated our whole profession, so that to most of us the name Lindgren and the words "economic geology" are inseparably linked. We are challenged by the example of his life.

Acceleration of trends which have been developing for several years was the outstanding feature of mining geology in 1939. These include particularly the greater use of detailed structural mapping. No less emphasis is being put on the study of the stresses which formed the structural elements, of wall-rock alteration or metasomatism, of paragenesis, and of the origin and nature of the ore-forming fluids, of the regional and continental frameworks for the ore districts, and of the significance of hot springs and fumarolic activity. None of these topics is new, but most of them are receiving increased consideration as guides to ore finding. Work in university laboratories continues, with rapidly improving techniques on mineral synthesis and alteration, petrofabric analysis and other petrography, and on the analysis of rocks and ores by chemical, microscopic, and spectrographic methods. Marked advance is being made in the study of the structure of the earth by seismographic and other geophysical techniques, the reaction of materials to high pressures and temperatures, the structure of equilibrium fields, and the lattice structure of minerals. With their ingenious knives the physicists seem to be dissecting the entire structure of the universe from fabrics measured in light years to the wave length of ultra-violet light and smaller.

One notes an increase in research and publication and an improvement in the quality of the work from such countries as Australia, South America, Africa, and especially Canada. The vast expansion of mining in these countries the last few decades is having noticeable effect.

The more or less distinctive divisions of mining geology will now be discussed:

STRUCTURAL CONTROL — Apparently the basic importance of structural control in the localization of orebodies is fast becoming recognized in academic as well as mining circles. Mining geologists are being permitted to institute the more accurate and painstaking mapping techniques necessary for adequate detail of structure. Papers by Dougherty,[20] Cameron,[13] Bruce,[9] Wisser,[67,68,69] Traill,[65] Goodspeed,[25] and Reed[57] contain much interesting information and illustrate the high quality of work being done. Schmitt[60] describes the relationship of certain contact pyrometasomatic orebodies to structural elements.

HOT SPRINGS—No philosophy on the theory of ore deposits can neglect consideration of hot springs and fumaroles. The last two decades have seen marked advances in knowledge of both of these closely related phenomena. Fenner[23] summarized the data in 1935. Early in 1939 Day[19] in a fine paper satisfactorily demonstrated that a large part of the flow of hot springs is derived from meteoric water, but that some as superheated steam is of igneous origin. He shows that the presence of particular elements earmarks certain hot springs as the expression of igneous phenomena. An interesting paper by Callaghan and Thomas[12] describes a commercial manganese deposit which resulted from hot-spring activity. Gianella[34] describes the hot springs at Steamboat Springs, Nevada, from which cinnabar has been mined and in which metastibnite, stibnite, and pyrite have been deposited. Ross[58] describes some cinnabar deposits in California. Fraser[28] gives important evidence backed by quartz spectrograph analyses of the close relationship between mercury deposits and epithermal gold and silver deposits.

When doing field work in California last year in connection with the study of a gold-silver deposit of the epithermal type which contained mercury, I mapped what appear to be fragments of a nearly horizontal erosion surface upon which hot spring activity had been established. Some gold ore associated with abundant alunite is mined just below this surface and the outcrop of the main oreshoot is only a few hundred feet below. It so happened that at the same time, independently and unknown to me, Fraser concluded from studies that the ore from the same mine was transitional from the epithermal gold-silver type to a shallow mercury type.

A paper by Park[54] describes commercial manganese ores associated with small amounts of cinnabar and native copper. This appears to be significant when considered with the evidence given by Callaghan and Thomas in the paper mentioned in the foregoing. Altogether, then, the study of hot springs and their relationship to ore deposition had a field day in 1939. Lindgren's careful philosophy on this association, plus the new published work, raises the implied relationships from the dignity of a theory to an approach to assured fact.

METASOMATIC PROCESSES—The study of metasomatic processes, or wall-rock alteration, judging from the literature, is receiving increasing and well-deserved emphasis as being pertinent in ore-finding problems. At least five good papers by Fisher,[30] Lopez,[45] Clarke and Elles,[16] Schwartz,[61] and McConnel,[50] treat this subject wholly or in part. Many orebodies or ore zones have characteristic envelopes of alteration, which, when studied, often delimit the blocks of ground that deserve exploration.

PARAGENESIS — The paragenesis of the minerals—that is, the order of their deposition, like metasomatism —was for years generally considered too academic for use in serious exploration. It is now recognized that the valuable minerals may belong to only one or several of many episodes or surges of mineralization which are marked off from one another by

periods of reopening. A reopening before the valuable surge may be expressed by mapable fissures, thus providing a guide to ore. Nearly all papers on the geology of mines and districts now include the paragenesis as an integral part of the description. As the microscope is essential for this work, it is becoming standard equipment for the geological departments of mining companies. This year many papers describe and discuss paragenesis wholly or in part. Those by Chapman,[15] Furnival,[30] Campbell,[14] Bastin,[2] Dyson,[22] Derry,[21] Wilkerson,[66] and Lovering[46] seem of particular interest.

OUTCROPS — The inspection and study of vein and other mineralized outcrops was possibly the first geology applied to mining. Yet today this seems to be a neglected field. Blanchard,[7,8] however, continues to publish with a high standard of excellence the results of work on limonitic gossans. His paper[8] is a summary of the work done the last three decades on gossans. Schmitt's paper[95] in part discusses outcrops and gossans as related to associated structural elements.

EXTENSION IN DEPTH—The need of study of the extension of oreshoots in depth, like the study of outcrops, seems to impress the field geologist more than the academic. Both are live subjects in the field, and, although a good deal of success attends outcrop study, predictions as to depth extensions—usually of paramount importance in a going mine—are often on an insecure basis. As most oreshoots extend to only shallow depths, the key to understanding depth extension of hypogene as well as supergene deposits may be in the consideration of factors largely related to the surface of the earth, particularly fracture and fault structures and meteoric ground water.

SUPERGENE ENRICHMENT — The subject of supergene enrichment seems fast becoming the stepchild of mining geology. With all the new techniques available, greater attention to detail and better understanding of hypogene processes, it would seem that great advances could be made in the understanding of supergene effects. In the field of application we need an unraveling of the snarl of minerals in epithermal deposits. This would aid the understanding of conditions in depth in this type of metallization. Rasor[56] presents some interesting data on the migration and precipitation of manganese at Tombstone, Arizona.

LIMESTONE REPLACEMENT — Good papers by Traill[65] and Behre[4] on the "epithermal" type of lead-zinc ores in limestone are balanced extensions of two basic papers by Prescott and Fletcher.[55,27] In a symposium edited by Bastin and dated the last day of the year,[3] fifteen contributors give data on the Mississippi Valley lead and zinc deposits. An exhaustive list of references is given and, after a careful weighing of data, Bastin and Behre conclude that the evidence favors a magmatic origin for the metals. Moore and others in the same symposium favor a genesis by descending meteoric waters, their chief arguments being that the ore deposits apparently are related to the present erosion surface. This seems to be a formidable block to the hypogene hypothesis as expounded. On the other hand, the arguments for a hypogene origin seem conclusive. An obvious suggestion which falls in line with the present-day knowledge of "igneous" hot springs is that meteoric water *may* have played a major rôle, but that the metals came from an igneous source, were absorbed by the ground water, and then deposited where conditions favored precipitation.

PETROLOGY — The petrologic and petrographic divisions of geology continue to attract the attention of exceedingly good men whose written production is on a high plane. Petrofabric analysis is the basis for considerable research. Papers by Ingerson,[43] Osborn[53] and Alling,[1] and many others illustrate the detail and the quality of the work being done. One feels hopeful that before long it will be possible to work out many, or possibly most, of the essential details of the mode of emplacement of igneous rocks and mechanism of the resulting metamorphism. This would aid the understanding of the genesis of the closely related ore deposits. A peak in the efforts in petrology was reached in December with the publication of a memoir by Buddington.[11] This was another of a series of fine contributions made possible by the Penrose bequest to the Geological Society of America.

REGIONAL FRAMEWORKS — The regional and continental frameworks of the ore deposits is drawing the attention of some. Billingsley and Locke[6] give valuable, but partly controversial, data on this subject and on many mines and districts. Broad regional relationships are also indicated by the symposium edited by Bastin[5] and apparently by Behre's paper.[4]

LABORATORIES — In the laboratories the alteration and synthesis of minerals appears to be attracting less attention than previously. The work being done, however, uses less empiric procedure than formerly. Two papers setting out the results of experimental work by means of high temperatures and pressures at the University of Minnesota were published by Gruner[37] and Lindner and Gruner.[47] Such work seems to be an invaluable adjunct to studies of metasomatism.

There also appears to be less research on polished sections. At any rate there is less published work, but the established techniques are gaining widespread recognition and use in problems of applied mining geology. There are few descriptions of mines that do not include the results of polished-section as well as thin-section work.

Thomson[64] reviewed the history and study of ore minerals and Gaudin and Dicke[32,33] continued their work on pyrosynthesis and iridescent filming. Schwartz[62] published a synthesis of data on bornite-chalcocite microtextures. Fraser and Huene[29] describe a dry polishing technique. Bell[5] describes the use of methyl methacrylate for mounting specimens in the laboratory. This medium, because of ease of handling, promises many advantages over other plastics which require pressure or baking. The removal of an inhibitor allows the material to set to a transparent, tough medium at atmospheric pressure and temperatures as low as 40 deg. C.

GEOPHYSICS—In the field of geophysics applied to mining one no longer hears much of the bally-hoo so characteristic of the work at its inception. Some effective work is being done where the objectives are closely limited and the technique is fully proved, such as methods used to find the depth of bed rock, follow faults, and like details. Lundberg and Grimes[48] give a fair, balanced exposition of the place of geophysical methods in mining today. They point out that geological work must form the groundwork and indicate the objectives. In short, they imply that geophysics, like the microscope, is another geological tool.

In the larger sense, geophysics has given the study of earth structure and composition a great impetus. Seismic technique using natural and induced waves is revealing and exploring lateral and depth differences in the composition of the earth. The philosophy of the geophysicists and students of earth structure is being rapidly and continuously integrated, as shown by a number of masterful papers by Mather,[40] Daly,[18] Bucher,[10] Gutenberg and Richter[39] and Ewing and Woollard.[23] A book on the subject was published by Daly,[17] and Gutenberg[38] edited a comprehensive treatise on the constitution of the earth. Various results of the work are really fascinating, such as new support for the planetesimal hypothesis,[40] a vitreous sima at a depth of 60 or 70 km., the hypothesis of continental drift, the extreme weakness of the asthenosphere, and the hypothesis

of earth shrinking due to molecular reorganization in the earth's interior. Such data must ultimately have a profound influence on our theories of the origin of ore deposits.

ORE GENESIS—There appears to have been little written on the theory of ore deposits during 1939, except for a paper edited by Bastin,[3] one published by Billingsley and Locke[6] and possibly Behre's, the text of which has not been published. Schwartz[62, 63] appears to have been consciously organizing certain fields in mining geology. Goodspeed's paper[35] contains interesting data on genesis. He presents a case for the emplacement largely by metasomatic processes of both igneous rock and associated ore by agents of common origin. This view supports a hypothesis favored by Holmes, Gregory, Billingsley, Locke, and Schmidt (See Holmes, 42).

Collection of data appears to have outstripped its integration, thus providing opportunities for research to individuals or groups with adequate equipment and time. Not that there seem to be enough field data of the quantitative type. The current mode of attack on the problems of genesis is like trying to solve the problems of chemistry or physics without laboratory work, for the main laboratory for geology is the field and for mining geology, particularly, the mine. What is needed is the sustained, cooperative effort of able geophysicists (in the broad sense), physical chemists and geologists *in the field* on several or more of the great ore districts. The spending of a few summer months on each district by one perplexed geologist is not enough if we are to raise mining geology to the position and dignity of a first rate science.

The literature indicates a recognition of the possibilities of mineral deposition in certain cases and phases by acid fluids (Lovering,[46]) and gaseous agents. This work is being helped by careful, quantitative work on paragenesis, metasomatism, and the stability fields of minerals.

APPLICATION OF GEOLOGY—McLaughlin's paper[51] on the geological factors in the valuation of mines gives an interesting view of the effect of geology on valuation, and, besides, provides valuable data on various districts. This paper should be read by all mining engineers and geologists. Farrell[24] sharply criticizes the current conservatism of mining company scouts and points out the well-known fact that many of the new mines are being found by local leasers and prospectors and few by the exploration departments of the mining companies.

The marked practicability of the results which may issue from research in mineralogy and geology is described by a number of current papers on clays—especially the absorbent clays. The paper by Garrison[31] makes revealing reading and other papers by Hayner,[40] Schroter,[61] Hauser,[41] and Norton[52] round out the subject.

CONCLUSION—This review perhaps leaves an impression of unrestrained enthusiasm for the progress apparently made in 1939. It is true that many seemingly academic ideas of a few years ago are being used to aid successful exploration for new ore. The teaching, theoretical development, and application of mining geology, however, seem vulnerable to criticism, but this will not be discussed at this time except to say that the excessive dogmatism which I believe exists in genetic theory is doubtless the result of lack of sufficien competition of ideas. There follows a pertinent statement by Dr. Alan Gregg[30] of the Rockefeller Foundation:

". . . this amazing homogeneity (in America) results in a kind of self-assured insularity, for there is real difficulty in finding able outsiders or distinguished critics or other persons proceeding from totally different axioms to challenge our uniform conclusions or throw our major assumptions into doubt. By as much as we are so large and so homogeneous our obvious differences are more superficial than they seem. This similarity of view in one area after another is simply not to be found in Europe . . ."

In compiling this review the geological, mining and other journals consulted include: *American Mineralogist, Bulletin* of the Geological Society of America, *Economic Geology, Engineering and Mining Journal, Journal of Geology, Mining and Metallurgy,* and *Science.*

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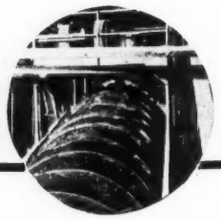

Mineral Dressing

Survey shows increase in application of sink-and-float process. New flotation reagents are studied. The problem of overgrinding. Improvements made in crushers and screens

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MUCH TRUTH is contained in the time-worn saying that "there is nothing new under the sun"; seldom does anything basically new appear. New combinations of old things, however, are the order of the day, and it is these new, improved, and modernized arrangements that are leading to improved economics here and to the solutions of old problems there. Research and operating experience have led to greater knowledge of the basic principles of processes and machines. Mineral separations by skilled processing based on physical and surface-chemical differences, a few years ago unknown or thought not to exist, are now easily made. Great strides are being made in the non-metallic (industrial) minerals field. In gold mining, both lode and placer, better recoveries and grades of concentrates reveal the trend. Rusty gold, thin-disk gold, and to a large extent flour gold are responding better to the improved processes. By ingenious machines and pulp circuits, flotation is being relieved by concentration in the grinding circuit.

Of interest at the head of the mineral-dressing flowsheet is the new vibrating grizzly-feeder. These grizzlies are placed nearly horizontally—the vibratory impulses are imparted to the grizzly bars at an angle, thus conveying the oversize forward. Blinding is almost, if not completely, obviated.

Another development nearly in this same category is the new Merrick Feed-O-Weight. This machine both totalizes and maintains constant the weight of material drawn from a supply source and fed to the grinding mill. Its use should not only simplify mill design and operation, but should lead as well to better concentrator performance.

In the secondary crusher field, perhaps the most interesting, although overdue, new contribution is the Allis-Chalmers hydraulic crusher-head relief. The thrust load of the crusher head in operation is taken at the butt of the spindle, which is seated on oil in a cylinder. The oil is held in the cylinder under a predetermined pressure as maintained by the conventional ball-and-spring valve. Thrust pressures in excess of that required to crush the rock feed, due to entry of steel objects, operate the ball valve, in turn allowing the crusher head to drop some 2 in., where it remains until the hard object has passed and until the operator, by means of a hand pump, brings it back to the operating set.

The hydraulic principle of giving relief to a reduction crusher in case of entry of steel is, in the case of the short-stroke, high-speed crusher, preferable to that of the coil spring. The coil spring resists the passage of the steel object through the many blows struck as the steel passes between the crushing faces, and the thrust load increases in direct proportion to the spring compression. This situation subjects a crusher to severe punishment.

The new crusher design, however, is not without objections, one of which is that when the main gear and eccentric parts are to be removed, this must be done from below.

Of jaw crushers, the new Straub Keu-Ken, typified by the absence of the conventional fixed jaw of all other jaw crushers, in which crushing is affected by direct pressure, is being watched with interest. For this machine, the manufacturers claim reduced steel consumption, lower power requirement, and the ability to crush run-of-mine to mill feed in one pass.

In jaw crushers, use of the Birdsboro-Buchanan removable-end toggle should lead to reduced crusher maintenance costs.

Jeffrey has recently announced what may be considered a radically new type of screen. The screening surface, unlike that of the woven wire, is formed by stretching parallel wires under high tension. The wire material may be either piano or stainless steel wire. For this screen, which is made in meshes from $\frac{3}{8}$ in. to 120 mesh, increased capacity and complete freedom from blinding are claimed. This development particularly interests me because I saw at Boise, Idaho, several years ago, what I believe was the original design of this type of screen. Although the screen seen there was not vibrated electrically, the performance mechanically vibrated was astounding.

Several new desliming classifiers have appeared. Generally, they are large in diameter, shallow, and provided with rake and rake mechanisms, such as employed in the pulp thickener, to convey the settled sand toward the center of the tank, from which point it is discharged. The tank may or may not be provided at its center with a hydraulic washing compartment. Such classifiers are in use at Homestake, Hecla, and other plants.

Kick vs. Rittinger (work done in crushing and grinding, *Pacific Chem. Met. Inds.* 3, No. 7, 1939) still survive. The results of this research show that Kick's and Rittinger's laws deviate greatly in opposite directions.

The one-step process of fine grinding so much to the fore a few years ago seems to have stalled, at least temporarily. A Seattle manufacturer now advertises a rock mill built in sizes from 6 to 20 ft. in diameter and of variable length. It is drum shaped and has four lifting shelves within the drum.

In the milling of ores there has long been the desire to avoid and minimize steel consumption. To this end, the rock mill in one form or another has been tried. This process, not a success to date, should not be given up as having no possibilities. Unfortunately, attempts have been made to do almost exactly that work with this type of mill which earlier the ball mill failed to do—namely, comminute in a single stage from mine-run to mill feed. There is no doubt, however, that the ball mill will continue to be a difficult competitor.

The rock-mill per unit volume, just as in the operation of the pebble mill, which is itself essentially a rock mill, can never compete with the ball mill with its heavier, more potent grinding media.

In fine grinding, the problem largely

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is to reduce overgrinding to a minimum. In terms of new surface produced, there probably is little difference in the capacities of various grinding mills. Improved grinding efficiency then is to be looked for by developing grinding circuits designed to prevent useless grinding.

Overgrinding not only represents useless expenditure of energy and excessive steel consumption, but invariably results in costlier processing and mineral loss. The purpose of grinding is, of course, to unlock those minerals to be separated. As soon as they are unlocked, dressing should commence or at least the possibilities of dressing be thoroughly considered. The dressing may have for its purpose removal from the circuit of either concentrate or gangue minerals. If a certain fraction of an ore (gold-carrying sulphides) requires finer grinding than the bulk, it should be recovered if possible from the pulp circuit and subjected to grinding on its own account. If there is liberation of a substantial percentage of reject minerals in the feed at relatively coarse grinding, much economy is to be affected by removing it from the system.

Prevention of overgrinding with its many costly results has been attacked by several methods, singly and by combinations. Some of the methods are as follows: (1) By improved classification; (2) by screening in the grinding circuit; (3) by designing ball mills to permit more rapid travel of pulp through the mill, thereby resulting in larger circulating loads and more classification per unit of original pulp treated; (4) by stage grinding; (5) by inserting in the grinding-classifying circuit a mineral recovery process; and (6) by methods of automatic control of important interrelated factors affecting grinding.

In the treatment of ores where needed selective grinding of a heavy middling fraction is not involved, use of the screen has an excellent chance of preventing overgrinding and thereby reducing grinding costs, at the same time with improved metallurgy. When a heavy middling fraction appears, as in the handling of most complex base-metal ores, screening in the grinding circuit does not lead to satisfactory metallurgical results, as was shown recently at the concentrator of the International Nickel Company. Also, probably screens have their practical and economic limitations at about 100 to 125 mesh.

Everything else being equal, probably the longer pulp remains in a mill, the more overgrinding results. In the trunnion-discharge type mill, the pulp volume is controlled (pulp density being constant) by (1) the size of the discharge trunnion and (2) the load of balls in the mill. In the grate-and-lifter type mill, the pulp volume is controlled by the ability and capacity of the lifter scoops to dip the pulp out at the bottom of the mill shell. Length of mill here also is a factor.

Recently there has been put into use a type of mill that is trunnionless or without pulp lifters. The entire discharge end is open, the ball load being held in by the conventional grate. There are no means to retain the pulp except resistance to flow of the pulp by the balls. In the operation of this mill, pulp consistency is of great importance and it may be operated at higher speeds than other types. There are now several installations of it. The Hollinger, in Canada, after carrying on extensive experiments found it economical to convert the company's rod mills to open-grate ball mills. This and other installations eventually will prove whether or not this departure in mill design marks a real advance in grinding.

The efficiency of the small pulp load has long impressed me, and this feeling dates back to the time of the research article published in T. P. 375 of the A.I.M.E. in 1931, and the high-speed experiments that followed in which the open grate was an absolute requirement. In these experiments, speeds above the critical failed, primarily due to high wear of liners, but they did show that the open-end mill had marked possibilities.

In fine-grinding to, say, not finer than 80 per cent through 200 mesh, the trend now is to single-stage operation. Single stage is, in a number of ways, more attractive than multi-stage operation, and is made possible by the availability now of finer feed and in turn the use of smaller balls.

The combination of factors, not including bearing friction, causing a mill to consume the maximum power also proves to be that condition for maximum mill capacity. There is, of course, a best set of conditions for any mill for optimum output. These conditions may or may not be (probably usually are not) embodied in any operating mill. Much systematic experimentation is required to find this critical set of conditions. Once found, however, great economy is to be effected by maintaining them constant.

Ball load, feed load, and pulp consistency all may now be placed under automatic control. The ball mill is controlled on the basis of the noise it makes, employing the "electric ear," and the classifier by the pulp density.

Applications of the "electric ear" (A.I.M.E. T. P. No. 1076, 1939) to ball mill control, of which there are many, has shown generally a 10 to 11 per cent increase in grinding efficiency. It is reported that in a test at the International Nickel plant at Copper Cliff, Ont., the "ear" increased the capacity of a 6½x12½ ft. ball mill 120 tons per day, equal to 11.2 per cent. An improvement of this magnitude should be rated as a major advance.

The Masseo automatic density controller maintains uniformity of classifier overflow regardless of variable factors. There are over 40 of these now in the field which are giving satisfactory service.

Overgrinding is being greatly lessened, mineral recovery improved, and increased economy affected by use in the ball-mill-classifier circuit of mineral recovery devices and processes, such as (1) amalgamation, (2) the flotation cell, (3) the corduroy strake, and (4) the jig. Amalgamation recovers free, clean gold. Flotation recovers free gold, gold-carrying sulphides, and sulphides. The recovery is not complete, although a single cell often may take out as much as 50 per cent and more of the total mineral content. Particles coarser than 35 mesh are not effectively removed. Corduroy catches fine and coarse gold, both bright and rusty, and in the latter respect the process has advantage over amalgamation or the flotation cell.

The jig has had a phenomenal comeback from the knock-out at the hands of flotation a few years ago. It is not uncommon now to find it in the grinding circuit. In most jigs, pulsations are effected through the medium of a flexible diaphragm, the diaphragm being actuated mechanically. In one instance, pulsations are affected by a water valve and in another machine known as the Peterson jig the diaphragm is air-actuated by a piston motor, the pulsation range going from 100 to 2,000 per minute. This latter jig is doing remarkable work on placer feed. It recovers bright gold by amalgamation and clay-encrusted fine gold in mercury traps.

Application of the sink-and-float process of mineral separation, employing heavy suspension media, is increasing. A recent contribution on this subject is by F. D. DeVaney and S. M. Shelton (U. S. Bureau of Mines, R. I. 3469). This process is covered by patents [1] and the American Zinc, Lead & Smelting Company is the exclusive agency for licensing the use of the process in the United States, Canada, and Mexico. During the past year, approximately 1,000,000 tons of lead-free zinc ore has been treated by its subsidiary at Mascot, Tenn., approximately 2,000,000 tons of lead-zinc ores has been treated in the Tri-State district; and on the Mesabi range about 1,000,000 tons of iron ore has been treated for the production of commercial ore. The three units are now treating between 4,000,000 and 5,000,000 tons of crude ore annually. At

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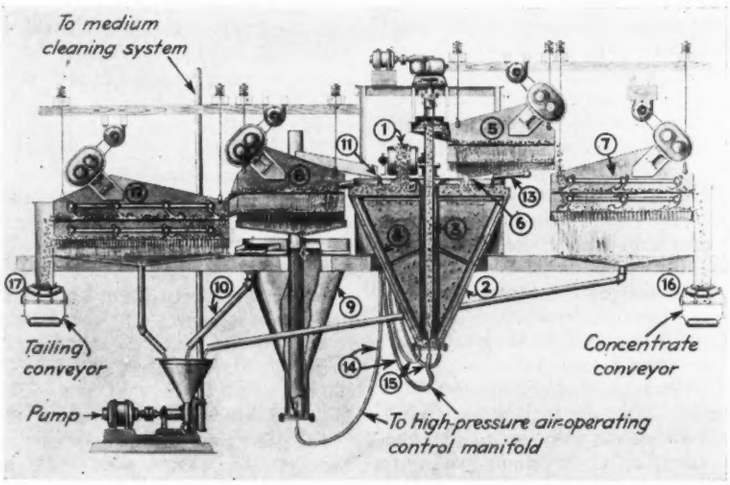
Mascot, Tenn., a lead-free zinc ore (gangue chiefly dolomitic limestone) is treated at the rate of 3,000 tons per day by the sink-and-float process, known as the Differential Density (D.D.) process. Prior to the advent of this process the flowsheet included jigging and flotation, 50 per cent of the original ore being rejected as ½-in. jig tailings. A striking contrast exists today at Mascot in that more than 60 per cent of the mine ore is being rejected as D.D. tailing, with the ore being crushed to 1½ in. Approximately 25 per cent of the mine ore is removed as ¼-in. fines and the tailing from the D.D. process, operating on the remaining 75 per cent of the crude ore, assays 0.35 per cent zinc, against 0.65 per cent zinc formerly made on the jigs. This indicates one advantage of this D.D. process—namely, the production of a large tonnage of coarse tailings, which, in certain localities, becomes an asset for sale.

The accompanying cut illustrates the separatory mechanism of the process. At Mascot the ore is crushed to 1½-in. and about 25 per cent thereof removed as fines and the remainder thoroughly washed to remove slimes. In the illustration (1) indicates the ore being fed to the cone, which is filled with the separating medium composed of crushed galena and water. At the top of the liquid mass, the gravity of the medium is maintained for the Mascot ore at 2.80 and at the bottom at 2.95. From the top to the bottom of the cone the specific gravity of the medium shows a constantly increasing differential.

The D.D. process is a true sink-and-float separation; the surface of the liquid mass in the cone is quiescent. No agitator is used and only a very slow rotary motion is imparted to the mass in the cone by the slowly revolving paddles. (4). Separation is accomplished by the particles of feed of greater than 2.80 specific gravity immediately sinking, and particles of lighter gravity floating and being carried off in the weir overflow onto the drainage screen (8).

The air lift (3) constantly removes the particles (principally mineral-bearing) settling in or near the bottom of the cone, along with a portion of the medium, which medium is returned to the top of the cone after having been drained through drainage screen (5). The medium overflowing with the floated tailing is drained and returned to the top of the cone at (11) through an air lift equipped with a surge cone (9). Any deficiency in the specific gravity of the medium caused by loss of galena in the process or by the entrance of moisture with the new feed is made up through a heavy density medium reserve supply (13) shown in the illustration. The screens (12) and (7) are washing screens for removing adhering fine galena after drainage. The galena (medium) thus removed is extremely diluted and is sent through appropriate equipment for removing colloidal slimes and sands, and is then densified and re-used for make-up medium (13) along with additions of new galena required.

At Mascot, the cost of operating this D.D. plant is slightly less than the cost of jigging as formerly practiced, and the recovery of zinc has been increased approximately 4 per cent over the recovery by jigging. The cost of crushing has been materially reduced in the order of 1½ in. instead of ½ in.



Flowsheet of the "differential density" sink-and-float process of the American Zinc, Lead & Smelting Company. Photo by courtesy of the company

1. Sized washed feed
2. (D.D.) Differential-density cone
3. Concentrate air lift
4. Agitator rake
5. Concentrate drainage screen
6. Return medium, concentrate drainage
7. Concentrate wash screen
8. Tailing drainage screen
9. Tailing drainage air lift
10. Tailing drainage overflow
11. Return medium, tailing drainage
12. Tailing wash screen
13. Medium make-up
14. Air to air lifts
15. Air for auxiliary agitation
16. Washed drained concentrates
17. Washed drained tailings

About 1.6 lb. of galena are added per ton of mine ore treated, of which 50 per cent thereof is reclaimed, so that the net cost of galena is approximately 0.8 lb. per ton of mine ore, or 3c. per ton of mine ore. Water is in closed circuit, so that practically no new water is needed. Power and labor are each approximately 1c. per ton of mine ore treated, so that the total operating costs are not in excess of 8c. per ton when operated on the basis of 3,000 tons per day. Intermittent operations can be conducted, provided provision be made to keep the medium in circulation to prevent excessive settling in both the cone and the tanks.

The purification of the medium washed from the tailings and concentrates is carried out at Mascot by tabling for the removal of sands and classification by decantation for disposing of the colloidal slimes entering with the feed.

Capital costs are not high, approximating $35 per ton-day for complete installation, excluding ore crushing but including building. This cost is based on 2,000 to 3,000 tons per day.

The density of a suspension is a function of the specific gravity, the size, the shape, and the number of particles suspended in unit volume being constant, density of the medium is a direct function of specific gravity of the solid phase. The following data were obtained from a large number of experiments.

Quartz (crushed) (20/28 mesh)	1.63
Quartz (Ottawa silca sand, 20/28 mesh)	1.82
Siderite (20/28 mesh)	2.11
Magnetite beach sand (20/28 mesh)	3.05
Galena (20/28 mesh)	3.77

The sands were in suspension in a rising current of water.

Suspension densities may be quickly estimated by use of the following formula:

$$D = \frac{1}{\%\text{ suspended solid by wt.} \times \text{sp. vol.} + \%\text{ suspension med. by wt.} \times \text{its sp. vol.}}$$

Thus, the density of a 50-50 suspension of galena and water is:

$$D = \frac{1}{.50 \times \frac{1}{7.5} + .50 \times \frac{1}{1}} = 1.8$$

For an 80-20 suspension, the density is:

$$D = \frac{1}{.80 \times \frac{1}{7.5} + 20 \times \frac{1}{1}} = 2.75$$

The density of a suspension also is a function of the density of the suspension medium. Usually the suspension medium is water. A method

of increasing the density then is to use a medium heavier than water. This may be done by loading water with colloidal mineral and using this colloidal suspension as the suspension medium for larger sand of the same mineral. Then for an 80-20 suspension of galena sand in colloidal galena medium-density of the colloidal solution, being, say, 1.8, is:

$$D = \frac{1}{.80 \times \frac{1}{7.5} + 20 \times \frac{1}{1.8}} = 3.7$$

Thus, in a suspension system involving one liquid, say water, and one mineral, say galena, super-densities may be had simply by loading the water phase with colloidal mineral, using the colloidal phase to hold the coarser solid in suspension.

By this process, I have produced galena-water fluid mixtures of density well above four. These fluid mixtures are, however, too viscous, complex, and otherwise too difficult to manipulate.

Parting (heavy) liquids, until recently valuable only in the laboratory, seem to be headed for a place in the commercial plant. Application of this process (Technical contribution, E. I. du Pont de Nemours & Company, Wilmington, Del.) is being made possible through cheaper production of parting liquids and "active" agents.

The modern flotation machine, generally speaking, is a nice piece of equipment, well designed for continuous service. Two general types still are in use. Some of the mechanical machines are provided with pneumatic equipment and facilities to enable the operator to adjust air volume to suit his taste. Others rely on their particular design and ability to give the needed aeration.

The so-called deep cell, depth being the means used to provide cells of large volume, is not so much talked of now as a year or so ago. At some plants (Britannia, B. C., and Chelan mill of the Howe Sound Company, *Min. & Met.*, 41, 1938), reported results are favorable, but less enthusiastic reports are received from others. In any flotation machine there is more than cell volume to consider. For example, in the square machine, cell volume varies as the cube of the cell size (side), and the frothing surface varies as the square of cell size. Doubling the depth doubles the volume, but the frothing surface remains constant. After all, the rate of removal of a floatable mineral from a unit volume of pulp must bear some relation to the number of bubbles (volume of air) to reach the cell surface in unit time. Since the volume of air reaching the surface of a cell is constant with depth, the way to increase cell capacity, it would seem, is to increase cell area in direct proportion to cell volume.

Many new reagents, both for floating and for depressing minerals, are being suggested, studied, and tried here and there, and on this problem and that. A great variety of mineral separations can now be made. On a southern Illinois lead-zinc-fluorspar ore (U. S. Bureau of Mines, R.I. 3437, 1939), lead, zinc, and fluorspar concentrates were successfully made. The reagents used were: xanthate to float the lead; $ZnSO_4$ and NaCN to depress zinc; copper sulphate to activate zinc; xanthate to float the zinc. In the fluorspar circuit, calcite and silica were depressed with quebracho and oleic acid was the collector. Overgrinding was detrimental.

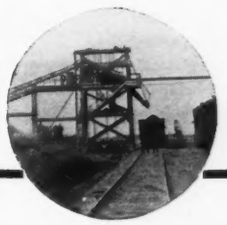
For molybdenite flotation, the Canadian Department of Mines and Resources (Memoir Ser. No. 69, 1939) found pine oil to be the best frother and kerosene the best collector.

Keck and Jasburg (*E.&M.J.*, 140, 1939) have found mahogany soap (Na salt of a sulphonic acid and a by-product of petroleum refining) to be a good collector of gangue minerals such as calcite, hematite, and epidote. Unlike oleic acid, it does not cause violent frothing in the presence of slimes.

The normal oximes have been found to be satisfactory reagents (*Jour. Amer. Chem. Soc.* 61, 1939) for the separation of the oxides, carbonates, and sulphides of copper from siliceous gangues.

Froth flotation is responsible in a large measure for a rapidly growing non-metallic (industrial) minerals in-

(*Continued on page* 91)



Iron-ore Beneficiation

Heavy-medium concentration applied in new commercial-scale plant on Mesabi, with research continuing. Possibilities of lower-grade ores receive attention; also flotation of fine tailings

JOSEPH RUDOLPH
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BENEFICIATION of iron ore experienced an active season in 1939. After a somewhat slow start at the beginning of the season, midsummer saw a quickened tempo, and toward the end production of concentrated ore was heavy. In some instances, operation of plants was stopped only by freezing weather.

Outstanding in new construction was the erection of a full size, commercial, heavy-medium cone plant in the western Mesabi district. This unit was built on the basis of results obtained in pilot-mill test work done in 1938. The plant, which is of all-steel construction, consists of two 7½-ft. diameter cones, with accessory shaking screens, air lifts, bucket elevators, thickeners, and magnetic separators. Ferrosilicon is used as the suspension medium. The rated capacity of the plant is 160 tons of feed per hour to each cone, or a total of 320 tons per hour. The material treated during the season was minus 1¼-in. plus 4 mesh in size. The deslimed minus-4-mesh material was treated in a new jig plant, consisting of seven Bendelari jigs and one Allis-Chalmers pneumatic jig. Both crude ore direct from the pits and mixtures of old jig tailings and tailings pond fines were concentrated in the cone-jig plant. Metallurgical results are reported satisfactory.

Research in heavy-medium concentration is continuing. One of the objectives is to treat materials finer than 4 mesh. A separating vat has been constructed for experimental purposes, and some tests have been made in which minus-1-in. plus-48-mesh feed was treated in one pass through the separator. Due to imperfect crushing previous to separation, some of the ore and waste pieces were as large as 3 to 4 in., and consequently the tests run were actually on material from this size down to 48 mesh. Results of tests

IRON ORE BENEFICIATION

already made show promise of success, and it is felt by the investigators that these tests prove definitely that material finer than ¼ in. may be treated in a sink-and-float process. Practically all heavy-medium separation work up to this time has been limited to materials coarser than ¼ in.

Further interest is being shown in the utilization of lower-grade, concentratable ores. "Lower grade" is here used in the sense that the crude ore contains gangue in all sizes, and differs in that respect from the straight wash ores, in which most of the gangue is minus-80 mesh in size. Such lower-grade ores require further treatment subsequent to the removal of lean fines. On the Mesabi, there are at present several plants equipped with jigs, and one heavy-medium cone plant, all of which are used to treat the lower-grade ores. Construction of two additional plants, which may have jigs or heavy-medium separators, or a combination of the two processes, is reported under consideration. On the Vermilion range, the first concentrating plant of any kind is being built. It has been reported that the plant will contain a grizzly, crushers, a picking belt, screens, jigs, and a classifier. Test work has shown that the ore can be readily concentrated, but the plant is too experimental from the economic viewpoint. The reason for this is that the ore to be treated will be obtained underground from old stopes which had been left by former operators, and the tonnage available, grade of crude ore, and combined mining and milling costs could not be estimated with the usual degree of accuracy because much of the ore is not in place and is mixed with glacial débris as a result of caving. The experimental plant is being built to determine the economic feasibility of the operation. If successful, the plant will produce a coarse concentrate which would be suitable for open-hearth smelting, and a finer jig and classifier concentrate which would be reduced in the blast furnace. A small jigging plant is being contemplated for the treatment of some low-grade ore at a Marquette range mine.

An installation new to the Mesabi was made in a concentrating plant in the western part of the district, in which a rod mill was installed to grind minus-¼-in. jig middlings to pass 20 mesh, the ground product being returned to the jigs with original minus-⅝-in. feed. The purpose of the grinding was both to liberate values and to make additional fine ore to aid the general jigging operation. It has been known for some time that jigging of iron ore is improved in a multiple-cell jig if the bed contains a sufficient amount of fines which are of middling grade or better. Some ores have about the right proportions of the various sizes, after desliming, but most ores do not have sufficient fines. It is therefore advantageous to produce the required amount of fines by grinding and recirculation. Test work has shown conclusively that metallurgical results are improved considerably by this procedure. Some engineers have felt that the relatively low value of iron ore does not warrant the expense of much grinding. Others have held the opinion that with proper operating conditions in the jigs, the amount of material to be ground can be kept sufficiently small in most cases to make the additional step worth while. It is probable that the grinding of jig middlings, by rod or ball mill, with recirculation of the ground product, will be more generally adopted in the future.

A worker in a large research institution is making investigations in which jigging of iron ores is being tried under conditions quite different from both the general practice and the methods indicated by recent experimental work. The radical departure from the prevailing methods is the use of a greatly reduced number of strokes per minute, together with a longer stroke. This method of jigging appears to depend on hydraulic classification to effect the separation of ore and gangue in an unsized feed, and the generally accepted concept is that a mobile bed of fairly high specific gravity is essential for the concentration of both the coarse and fine portions of such a feed. It is believed by the investigator that the slower speeds will result in considerably greater capacity per unit of jig screen area, with metallurgical results comparable to those currently obtained. Some engineers in the field agree that capacities would be increased by this method of jigging, but are doubtful of metallurgical results, calling attention to the probable difficulty of obtaining sufficiently concentrated hutch products and lean tailings.

Some interest continues in the possibilities of applying flotation to the recovery of ore from fine tailings. A representative of a large manufacturer of flotation reagents recently inspected the field, and some small-scale testing is currently in progress. Among other problems that would require solution in this field is the successful treatment of materials which may vary widely in composition from time to time. The larger tailing ponds are not homogeneous in mineral content, nor does a washing plant produce the same kind of fine tailing day after day. The several horizons of the iron formation vary in chemical and mineralogical composition, and the ores, concentrates, and tailings differ accordingly. The values in the fine tailings may consist of hematite, magnetite, martite, geothite, limonite, other hydrated oxides of iron; the gangue may be chert, quartz, and paint-rock slimes, or all of these in various proportions. A specific flotation operation suitable for one feed may not be at all suitable for another, and sometimes the feeds may change several times in a single shift.

A large washing plant in the western part of the Mesabi is being moved some two miles to a location near the open pit which has served the plant. Ore from the pit had been previously raised and transported to the washing plant by steam locomotive haulage. With the new arrangement, the crude ore will be raised from the pit by means of a belt conveyor, which will deliver the material directly to the plant. The new location should result in lower total production costs.

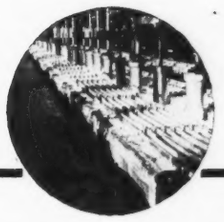
Capacity of another washing plant in the same section of the Mesabi is to be increased by erection of an additional one-half unit plant. Like the main plant, the new unit will treat straight-wash ore, and will contain a grizzly, shaking screen, log washer, and bowl classifier.

At the New Helen mine, in Ontario, a large sintering plant was put into operation, treating siderite ore of 35 per cent iron and raising the grade to 51 per cent iron or better. Capacity of the plant is 2,000 tons per day. Some of the crude ore contains several per cent of pyrite, which is utilized as fuel in the sintering process.

In the Mineville-Port Henry magnetite district in New York State, dry magnetic separation is being replaced by the wet magnetic process.

The research laboratory of the State Mine Office at Hibbing, Minn., has been investigating the occurrence of rare earths and other rare metals in certain painty horizons of the Biwabik iron formation and in the Cretaceous layer.

In conclusion, it may be stated that the art of beneficiating iron ores has been advanced at a normal rate during the year. Some new knowledge has been acquired, and an effort was made to apply in a more effective manner that which had already been known. Most of the work has naturally been concerned with problems of immediate interest, but work having future possibilities has not been neglected. There is reason to believe that the years to come will see an expansion in the beneficiation of iron ores, both in plant capacity and metallurgical efficiency. Such development must, of course, be made on a sound economic basis, and it is to be hoped that those who will guide the political destinies of the iron ranges will encourage continued progress by refraining from the imposition of excessive tax burdens.



Electrometallurgy

Production of aluminum expands; anodic oxidation of its alloys studied. Magnesium investigations continue. Possibilities of porous carbon electrodes draw attention

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THE ALUMINUM COMPANY of America completed in 1939 its $26,000,000 program of expansion started in 1937, most of it being spent at its operations in New York and Tennessee. At the end of the year it was announced that the company would soon begin building a reduction plant at Vancouver, Wash., which would use electric power from the Bonneville dam, at Portland, Ore. Initial capacity is to be 15,000 tons of aluminum per year, making the company's total capacity over 200,000 tons per year in the United States. A power contract was signed for 32,500 kw. for twenty years at $17.50 per kw.-yr. Building the plant is expected to take about one year. Further expansion of plant and power are future possibilities. The present Bonneville output capacity of 86,000 kw. is only a small part of its potential capacity.

British Aluminum Company, Ltd., was importing bauxite from its property in southern France during 1939 for the new plant at Newport, Wales. British production of metal in 1939 should show an increase over the figures for 1938, as should most other producing countries. France's rate is expected to be up at least 20 per cent by the end of 1939, with a new plant having come in. Norway has six reduction plants, but little domestic bauxite. Sweden has one at Mansbo, north of Stockholm, the capacity of which it is expected to double from 1,900 metric tons per annum. As a preparedness measure, 35 to 40 per cent domestic material is being considered as a substitute for imported bauxite. The Billiton Company, of Holland and the East Indies, in collaboration with the Swiss Aluminum Company, planned a reduction plant of 5,000 tons (metric) per year, but construction was expected to take several years. Denmark comes into the picture indirectly by acquiring a 50 per cent interest in 1940 in the Greenland cryolite concession. The one deposit is said to be good for about 75 years. No other of note has been found to date in Greenland or elsewhere. Presumably war conditions will make for increased use of artificial cryolite. The Greenland cryolite has been going to two companies, one the Pennsylvania Salt Company, Philadelphia, which treats the ore and distributes the refined product to the Western Hemisphere, the other the Oresunds Kemiske Fabriken, Copenhagen, which treats ore also, and distributes the refined product to European buyers.

Germany had one more new plant available in 1939, the Lippe, at Lunen. The desired rate of increase has been slowed down by shortage of electric power, engineers, and trained workmen. Bauxite imports in 1938 were about 1,200,000 metric tons, of which Hungary supplied 363,000, Yugoslavia 348,000, Netherlands East Indies 193,000, Italy 96,000, France 92,000, and Greece 85,000. Domestic bauxite output remained small. Production from other domestic raw materials remains uneconomic and small in amount. Attempts to increase it at this time would increase the difficulties mentioned in the foregoing. The countries incorporated into the Reich swell the aluminum production but little. They add materially to processing (metal-working) plant capacity. Austria is reported to have a potential hydro-electric power supply of 23,000,000,000 kw.-hr. per year, but only 3,000,000,000 of it was producing in 1937, so that it is of little present help. Germany's electrochemical and electrometallurgical power consumption in 1937 was about 11,000,000,000 kw.-hr., of which aluminum required about 2,600,000,000. Practically all German water power is being used at full potential capacity.

Italian reduction plants at Porto Marghera, Mori, and Bolzano were enlarged, so that increased production figures are expected for 1939. The first Italian plant, now idle, was built in 1907 at Bussi (Aquila), with a capacity of 900 metric tons of metal per year. The second, built in 1916 by French producers at Villeneuve, having a capacity of 800 tons, was transferred to Borgofranco, near Turin, after the last war and is still operating. In 1938 five plants had a total capacity of 30,000 tons. Italy has large deposits of good bauxite and numerous sources of cheap hydro-electric power. Much of the bauxite is found in Istria, most of the rest in the districts of Abruzzi and Campania. Well over 100,000 tons is exported per year under normal conditions. Total reserves of good bauxite have been given as 34,000,000 tons, of which one-third is considered suitable for the Bayer process and two-thirds as having too much silica for it. Italy is deficient in coal, required for processing bauxite into alumina for the electric furnaces, and in coke for electrodes. There are three important groups of producers: Montecatini (Italian), Aluminum Industries A. G. (Swiss), and Aluminum Company, Ltd., (Canada). Present plans call for expansion of reduction capacity to 55,000 tons by 1941, and an ultimate national goal of 100,000 tons. In the 1941 program Porto Marghera is scheduled for 20,000 tons, Borgofranco 3,000, Mori 15,000, and Bolzano 16,000. The Hoagland process plant built for Porto Marghera in 1929 is reported unsatisfactory. The Jourdan process for leucite ore was also tested, but a large plant was not built. Government work on leucite continues. To date the Bayer process is preferable. The domestic market is reported controlled by S/A Aluminio, Milan.

India was slated to have a plant of 3,000 tons metal per year near Asensol, Bengal, to be built by joint action of Aluminum Company, Ltd., of Canada, and British Aluminum Company, Ltd.

Japan has six companies producing. Total capacity is supposed to be about 35,000 metric tons metal per year. With every effort the production in 1938 was under 20,000. Consumption was just about twice production. Because of this a new company was formed which might become the most important, the Nip-

pon Light Metal Company. Initial production for its program is 3,000 tons by 1941; the ultimate, 50,000. The financing parties are Tokyo Electric Light Company, Furukawa Electric Engineering Company, the Mitsui, Mitsubishi and Sumitomo interests. Six other companies with production programs are in the field. National expansion has been slower than desired because of shortage of coal, hydro-electric power, and slow equipment delivery. Germany has been the chief supplier of the last, so the war increased the difficulties. Production costs are believed to average about 1,700 yen per ton, of which foreign bauxite (mainly from the Dutch East Indies) represents about 10 to 15 per cent. Bauxite production is being pushed from Palao Island, South Pacific, an ex-German, Japanese-mandated island. Japan is also short of electrode coke.

From an investigation of anodic oxidation of aluminum alloys the Aluminum Company of America determined that the appearance, uniformity, color, density, and porsity of the coating are related to the type of alloy, its temper before coating, type of electrolyte used, and coating conditions. Electrolytes in general use contain sulphuric, chromic, or oxalic acids, or combinations of these.

ANTIMONY—Trail has been going ahead operating its 4-ton electrolytic plant. The Kellogg lead smelter is working toward a separate department for the antimony-bismuth bearing materials coming to it. An electrolytic antimony plant is planned.

BERYLLIUM—Production continues to run behind the hopes and desires of companies and governments, with world output under 500 tons per year. United States and Germany are the chief producers. Ore supplies to the United States, including imports from Argentina and British India, have exceeded requirements the past year or so. Ore prices represent about $1.25 per pound of metal recovered.

COPPER—Production of electrolytic copper in the United States increased considerably during the latter part of the year, as it did elsewhere. Installation of the second electric melting furnace for finished shapes by International Nickel at Copper Cliff was completed and both furnaces were operated. It has been found that poling introduces more gas into the molten copper than was generally assumed. Electric melting eliminates this introduction of gas.

Outokumpu, Finland, has gone ahead with the program for its 12,000 metric tons per year electrolytic refining plant, even since the U.S.S.R. invasion began. Plans call for starting it within a year. As reported in

ELECTRO-METALLURGY

a previous review, the concentrate is smelted in a large electric furnace. Most of the small amount of zinc in the concentrate is now removed by flotation, in this way improving smelting.

Germany is developing new low-grade deposits at Kur-Hesse, the metal to be refined in the new Hettstedt (Mansfeld) refinery. Output of the Bor refinery (Yugoslavia) for 1939 should be well above 50,000 metric tons. That of Kromparchy refinery (Slovakia) may reach 3,000 tons' output for 1939.

The U.S.S.R. program continues to run behind plan figures. The Pyshma refinery (Sverdlovsk) is slated to be enlarged to 100,000 metric tons per year; the new Krasnouralsk, also in the Urals, is to have a capacity of 125,000 tons. There are seven primary smelters now: Kirowgrad, Krasnouralsk, Karabasch, Karsak-Pai, Bamaik, Sangesur, and Allaverdy.

Noranda bought the British metals Corporation interest in Canadian Copper Refiners, Ltd., and now holds 85 per cent, Phelps Dodge holding the rest.

IRON—This review is not intended to cover iron electrometallurgy, but it should be noted that practically all stainless steels are made in electric furnaces; also that production of these steels in 1939 may be double that of 1929.

LEAD—Electrolysis of fine galena, dissolved in fused lead chloride on a semi-commercial scale, was reported last year. Graphite or carbon electrodes were used, as neither oxygen nor chloride was liberated at the anodes. The galena in solution was kept at 2 per cent of the bath. Insoluble minerals float and are skimmed off. Silver, antimony, and bismuth sulphides dissociate and the metals enter the lead as impurities. Electrolysis is carried on at 500 to 600 deg. C. Sulphur is drawn off above the anode compartment and condensed. The cell was made of firebrick. The lead is drawn off by a cast-iron siphon. Average analysis over a fairly long period was: 6.6 oz. Ag, 0.029 Sb, 0.014 Zn, and 0.0086 per cent As plus Fe plus Bi; Pb (by difference) was 99.93 per cent.

Current lead output at Trail is at the rate of over 200,000 tons per year, of which 60 per cent is contracted to the Empire during the war. Current zinc output is 130,000 tons, of which 75 per cent is allocated for war purposes. It appears that Trail can supply almost one-third of the war requirements of these metals.

MAGNESIUM—A French investigation confirms the idea that a magnesium surface oxidizes in air to the hydrate, which in turn changes to a basic carbonate. In this it behaves like zinc, but the oxidized coating on magnesium seems to be more porous and non-protective. Pure magnesium was found to corrode more easily than the less pure, the cast form more than the rolled. Electrodeposition of copper on it was reported as forming a porous coating which does not protect.

In the United States investigation continued with a view to using the magnesium deposits of the Northwest and the abundant hydro-electric power there. The Bureau of Mines collaborated. The German plant at Bitterfeld, which has been using waste liquors from the carnallite operations, has been changing over to Austria's high-grade magnesite. It was found comparatively difficult and costly to get anhydrous magnesium chloride for the fused electrolytic bath from these liquors. German costs, before later improvements, have been given as follows per metric ton of metal:

	Reichmarks
4300 kg. anhydrous $MgCl_2$ at 18.50 marks per 100 kg.	796
110 kg. electrodes at 50 marks per 100 kg.	55
20,000 kw.-hr. power at 1.5 pfennigs	300
360 man-hours labor at 0.99 marks per hour	324
General maintenance costs	140
Miscellaneous expenses	220
Total	1,835

In Japan a half dozen or more companies are in the field and the nominal aggregate capacity is supposed to be around 15,000 metric tons.

MANGANESE—The more recent work of the Bureau of Mines was summarized in the December issue of this magazine.

Using lead anodes in electrolyzing manganese results in about 20 per cent of Mn in the feed solution being oxidized and precipitated (30 per cent of the Mn deposited on the cathodes). Fink and Kolodney report that anodes, composed of 30 to 50 per cent Sn, 0.3-0.4 per cent Co, and the remainder of lead, practically eliminate this oxidation, resulting in tank-room economies in several ways.

NICKEL—International Nickel Company, through its British subsidiary, has been developing a promising deposit of ore near Petsamo, Finland, for the last seven years. Construction of a smelter, hydro-electric power plant, and electrolytic refinery was energetically pushed during 1939 with a view to starting production by next autumn. An output of 6,000 short tons per year of nickel and 3,000 of copper was planned. Total expenditures, including mine development, were expected to reach $10,000,000 and considerably more than half has been expended to date.

The U.S.S.R. has spent much time and money trying to develop adequate nickel production, but only small tonnages have resulted. Ore developments have been disappointing, most of the ore treated to date being low-grade hydrated silicate apparently on the order of the richer deposits of New Caledonia. The Petsamo development was probably a factor in the move against Finland. Falconbridge Nickel Company's electrolytic refinery at Christiansand, Norway, continues to refine the copper-nickel matte from the property in the Sudbury district, Canada. The matte averages about 61 per cent Ni, 21 Cu, 15 S, and small amount of the precious metals.

TIN—Phelps-Dodge has been doing research for several years on both primary and secondary tin-bearing materials. A semicommercial plant at Laurel Hill is producing around 100 tons per month. The flowsheet is set up to make either solder or refined tin and lead separately. American Metal Company is likewise investigating refining of South American tin concentrates and other tin-bearing materials at New York.

The first electrolytic tin plant in Holland was established in 1939. It, also, will treat ores and secondary products. Three of Germany's tin plants are listed as electrolytic.

ZINC—Developments in the electrometallurgy of zinc may be found in the article on the metallurgy of zinc in this issue.

GENERAL—Interesting possibilities for porous carbon electrodes have been brought out by G. W. Heise, in *Transactions* of the Electrochemical Society, Vol. 75. Through such electrodes reactants may be admitted or products may be withdrawn from the cell. They may offer a means of doing without diaphragms in some cases, thus reducing voltage requirements and other costs; may permit continuous operation where only batch operation is normally possible, permit maximum concentration of reactants at the active electrode surfaces, reduce polarization to a minimum, permit increased current density or decreased electrolyte concentration, control oxidation or reduction to a greater degree, and permit maintenance of constant electrolyte composition. These electrodes are claimed to have amply demonstrated their usefulness in laboratory work and to promise value in large electrochemical operations.

ACKNOWLEDGMENTS—I wish to acknowledge the many sources of information which have been drawn on for this article. Lack of space prevents detailed mention, but in justice to them any quotations should be given as coming from a review.

Copper Metallurgy

Smelters in Southwest and in Canada exhibit interesting differences in practice. New Hurley plant ideal. Noranda uses slag and tailings for stope filling underground

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COMPARATIVELY few changes and improvements in copper pyrometallurgy can be reported for 1939. Copper production was generally curtailed until the outbreak of war in Europe in September. Because of the war, it is difficult to obtain information from plants outside of North America.

On a recent trip to the Southwest, I had the opportunity of seeing the new Chino smelter at Hurley, N. M., and of noting some of the developments of the last few years at other copper smelters.

The Hurley smelter, which was blown in in May, 1939, is, in construction and operation, the realization of many a smelterman's dream. It shows what can be accomplished by intelligent cooperation and coordination between designing and operating branches of an organization. The plant has been described in various publications, but no mere description can be as adequate as a visit, when one is impressed with the ample room, the freedom from dust and gas, the complete mechanization, and the adequate provision for collecting dust from waste gases. The plant is the latest example of the present trend to "wet charging" of high-grade concentrates and eliminating the costs and losses in roasting.

Several differences were noticed between reverberatory furnaces practice in the Southwest as compared with practice in Canadian plants. In the American plants, sprung arches of silica brick are used exclusively, whereas in Canada all copper and copper-nickel reverberatory furnaces have suspended magnesite roofs in the smelting zone at least, and many have suspended roofs for the full length of the furnace.

A second notable difference is that in most of the American plants the cross-sectional area of the furnaces is uniform throughout their length, whereas in most furnaces in Canada, the height of the roof at the firing end is increased to provide more area for combustion in the smelting zone, the cross-sectional area being decreased toward the front end.

R. A. Wagstaff has furnished a concise tabulation of the important changes in reverberatory practice in the Southwest in the past ten years:

1. From center-feed deep-bath smelting to gun-feed side-charge deep-bath smelting.
2. From oil or coal firing to natural-gas firing.
3. From large-type single gas burners to multiple-type gas burners.
4. Increased width of furnaces in most plants where increased tonnages were demanded.
5. Increased areas for exit gases in uptakes and boiler settings, thus permitting increased fuel consumption and higher tonnages.
6. Side-wall skimming of furnace, thereby avoiding contamination of slags by uptake drippings.
7. Increased life of furnace arches, due to (a) Better fuel burners, (b) Decreased velocity at burners, (c) Gun feed causing less dusting, (d) Retarded combustion during charging period, (e) Use of secondary arches in combustion zone.
8. Use of an air gun with silica slurry for hot-patching of weak spots in silica-brick furnace arches and up-

takes, thus prolonging furnace campaigns.

9. Finder grinding (or crushing) of coarse ore in charge make-up.

10. Judicious use of lime for better metal recovery.

C. R. Kuzell, of Clarkdale, Ariz., reports a return to oil firing after nearly twenty years of firing with pulverized coal. This change in fuel was made for economic reasons. The new oil burners were designed of large capacity so that sufficient oil could be burned to increase the smelting capacity up to 1,500 tons per furnace day. When running two furnaces it was possible to put through the plant, during one month, 98,342 tons of new metal-bearing material, with a fuel consumption of 2,480,000 b.t.u.'s per ton of new revenue-bearing charge. This is remarkable.

H. F. Easter, of Arizona, reports that the installation of air-tight connections on the calcine hoppers at the roasters has minimized dusting.

G. P. Schubert, of Michigan, reports that, with limited output and intermittent operation, he has found it advantageous to return to the use of clay brick for reverberatory furnace arches instead of silica as formerly used. This he attributes to the much improved quality of clay brick and to the ability of clay brick to withstand thermal shock much better than silica. The thermal shocks are due to the repeated opening and closing of large charge doors and to intermittent operation on account of shortage of material to smelt.

The new smelter which was under construction by the International Nickel Company near Petsamo, Finland, is in the fighting zone between the Finns and Russians, and it will be some time before its ultimate fate will be known.

J. H. Ambrose, of Flin Flon, Manitoba, reports a record year for tonnage smelted and copper production (including custom concentrates). The four roasters, two of which ran the whole year without a shutdown, averaged 350 tons of feed per roaster day. Electric air preheaters are in use on them and have greatly reduced the amount of coal required.

During the last few months the reverberatory furnace has averaged 1,320 tons per furnace day. There was only one shutdown during the year for major arch repairs, when 60 ft. of the main arch in the smelting zone, and the corresponding length of side walls and the burner wall, were replaced. No repairs, except two minor patches, have been made to the front end of the furnace since April, 1937.

On many occasions, depending on the nature of the feed being treated, the furnace could have smelted a greater tonnage, but the capacity of the converters to handle the amount of matte produced was the limiting

COPPER METALLURGY

factor. The side burners on the furnace have continued to function satisfactorily, and they contribute greatly to the amount of feed smelted. Fuel ratio was about 10.75 per cent per ton of solid charge smelted. The coal used contained an average of 13,500 b.t.u.'s per pound.

A third converter is now being installed which should be in operation by the beginning of 1940. It is planned to smelt a considerable tonnage of custom copper concentrates directly in the converters. This practice will permit the treatment of an equal additional tonnage of the company's own concentrates in the reverberatory furnace.

To avoid shutdowns because of hydro-electric power failures, a steam turbine generator has been installed in the power house and is supplied with steam from the waste-heat boilers. In turn it supplies power to the coal plant, which can be automatically switched to the hydro-electric power. The waste-heat boilers are also equipped with powdered-coal burners, for direct firing, and there are available, also, two stoker-fired standby boilers. Thus the plant is protected against any ordinary power failures.

At Noranda, a new Wedge roaster was put in operation in June, making ten roasters in all. The new unit, 25 ft. in diameter and with seven internal hearths, is similar to the original roasters except that the shell and central shaft are of stronger construction, and complete and improved insulation has been provided for both shell and shaft. In addition, an increased number of drop holes have been provided on the "out" hearths, giving a drop-hole area per hearth of 51 sq.ft., compared with 34 sq.ft. in the original roasters.

A campaign of rebuilding the original roasters has been started and two roasters have already been completed. In addition to strengthening and repairing the shells and central shafts, the shells are being insulated both inside and out. "Out" hearths are being rebuilt, with a drop-hole area the same as the new roaster. The advantages that will be gained by these changes are: (1) lower gas velocities through the roasters, resulting in less flue dust; (2) lower fuel consumption; (3) better sulphur elimination, when necessary; (4) less corrosion of the steel shells; (5) hotter calcines; (6) better working conditions with the shells insulated.

Throughout the year the roaster Cottrell dust has been transported by means of venturis from the Cottrell collecting hoppers back to the next-to-bottom hearths of the roasters. This has been entirely satisfactory. The pipe bends which are eroded rapidly are being replaced with long-sweep cast elbows. This method, which allows the Cottrell roaster dust to be intimately mixed with the calcines, has increased the tonnages on the reverberatories, decreased the dust made by them, and has not built up in this time an excessive circulating load on the roaster Cottrells.

A multiclone was purchased, and is to be installed on one roaster in January, 1940, so that the bulk of this roaster's dust will be returned to the roaster at a temperature of approximately 1,000 deg. F. This should increase the temperature of the calcines.

No. 1 reverberatory has run continuously for 21 months without a shutdown for repairs. Occasionally, the fire has been shut off for half an hour to change a coal burner. Whenever the roof becomes too thin in any spot, the brick-masons replace the burned-out suspended brick with new brick without cutting the fires or affecting the tonnage. During this campaign the furnace has smelted almost 1,000,000 tons of solid charge.

No. 2 reverberatory was shut down once during the year, in December, to change the by-pass flue so that another waste-heat boiler could be installed. As soon as the present stock of silica brick has been used, both furnaces will be equipped with suspended magnesite roofs for their full lengths.

Advantages of suspended magnesite roofs at Noranda have been demonstrated by these long campaigns at high tonnages and by the fact that during the last two years the total cost of furnace repairs has only been a few cents per ton of solid charge.

Proper backfilling in mines with large stopes is always a difficult and expensive undertaking. At Noranda this problem has been solved by the use of waste reverberatory furnace slag and sulphide tailings from the concentrator. A mixture of six parts of dump slag, three parts of granulated slag, and one part of tailings is used, after experiments had shown that such a mixture would, on standing, develop the strength required for fill in large stopes.

Granulated slag is made by "shotting" the current reverberatory furnace slag in a novel manner. The molten slag is poured from the slag pots over wide cast alloy-steel launders into a large concentrate tank, filled with water, the granulated slag being reclaimed by a crane using a perforated clamshell.

H. S. McKnight, of Canadian Copper Refiners, Montreal, reports that the tank house has been enlarged.

Ontario Refining Company, at Sudbury, Ont., has installed a second electric furnace for melting cathodes in the production of vertical cast and other shapes.

Lead Metallurgy

Sintering continues prominent role in connection with blast-furnace operations. Rough-drossing plants help reduce refinery costs. Sulphur recovery. Lead-alloy production progresses

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GENERAL economic conditions obtaining at the beginning of 1939, including the opportunity for an increased demand for lead on the outbreak of war, were not such as to increase greatly either lead production or expenditures for new equipment. Late in December, 1939, the British Ministry of Supply increased its maximum price for lead from £17⅝ per long ton to £25 (from 3.15 to 4.47c. per pound with the pound sterling at $4), seemingly with the objective of stimulating an increased world production, including possibly that of the United States. However, the Trail smelter of the Consolidated Mining & Smelting Company of Canada was reported (*Min. & Met.*, Dec., 1939, p. 534) to be producing 17,250 tons of lead (and 12,450 tons of zinc) per month; from earlier figures the plant capacity of the Broken Hill company could be readily increased, and the plant made a new record for production in 1938.

Before the outbreak of war, when both information and lead products were more freely exchanged in general, each smelting company not provided with great mines was seeking new ores from colonial or foreign sources. Non-ferrous production in Germany reached an all-time peak in 1938. Production of lead from Austria was greatly increased, and the recently annexed countries were being vigorously prospected. Developments in Rumania and Poland were reported. Bulgaria was being prospected. Bolivia was trying to increase her lead production to make her economy less dependent on tin, and to place the production of metals more largely in the control of national officials. Countries producing metals were more urgent in desiring these metals to be treated in the country of origin. Last year it was noted that Cerro de Pasco installed a Betts' refinery and that Trepca considered the establishment of a plant in Yugoslavia. A small mechanical hearth plant was discussed for Argentina.

What effect the war will have on the development of new lead properties and plants is hard to forecast. In the spring of 1939 it was thought that the Trepca would start operation in October and that by the end of 1940 the smelter would be treating 70,000 to 80,000 tons of 80 per cent lead concentrates per year.

SCOTCH HEARTH PLANTS—The Trepca smelter was to use Newman mechanical hearths. Another Yugoslav plant is now using mechanical ore hearths, it was stated by Charles W. Loch in the *Mining Magazine* (London, Oct., 1939, Vol. 61, p. 201). The concentrator at Mezica is treating yearly 110,000 tons of ore containing 13.5 per cent lead and 5 per cent zinc. A series of jig concentrates +18 mm. to −1 +0.75 mm. in size is made. Some table concentrates are also made. Assays were not given, but the products were seemingly rich; the lead sulphide flotation concentrate contained 75 per cent lead. The oxidized, sulphidized concentrate removed last contained 40 per cent lead. An interesting innovation to those wishing to increase the capacity of the Scotch hearth is sintering of the fines on the D. & L. This "sinter," from the probable richness of the feed, might well be chiefly agglomerated sulphides. It is sent to join the coarser gravity concentrates as feed to three mechanical hearths, one of which is usually held in reserve. The gray slag from the hearths is smelted in a small blast furnace 1.75 meters in diameter and 10 meters in height. The mechanical hearths contemplated, together with those already in operation, as at Galena, Kan., and Federal, Ill., would produce an appreciable fraction of the world's lead.

TRENDS—As indicated, in general the lead smelters in the United States did not increase their capacity greatly in 1939. Most of the plants held themselves in readiness to smelt an increased tonnage, should the price of lead advance markedly and the receipts of products to be smelted increase greatly. The sintering equipment in the average American smelter is being operated more nearly at capacity than the other units to make "quality, predigested (that is, partly reduced) sinter" for the blast furnace. The use of a little coke on the "second-over" machines is common practice. These plants noted as having installed 63-in.-wide pallets last year for the "second-over roast" were smoothing out operations during the year. (The Port Pirie plant now has a wide (10-ft.) pallet on its "first-over" sintering machines, as well as its "second over.") It was reemphasized that the sintering plant is still the most controllable smelting unit, repaying best the efforts of lead-smelter metallurgists, and that it is difficult to overstress the importance of proper preparation of the sinter charge from the time its ingredients enter bins until they have been bedded and ignited on the pallets.

To fit present industrial conditions in the United States it is desired to smelt all the feed in one blast furnace, operated intermittently by one crew within the hours of the Wagner Act. With the care given to the preparation of virtually "all sinter" charges, several blast furnaces of standard size are now smelting steadily around 600 tons of charge per day or even a little more.

When the capacity of the standard Bunker Hill blast furnace was not quite large enough for such an operation, a larger furnace was built (*E.&M.J.*, Aug., 1939, Vol. 143, p. 63) similar to the one at Trail, 66x252 in. at the tuyères, having 2½-in. tuyères at one half the spacing of the ten 4-in. tuyères in the old standard 48x180-in. furnace. Even with a charge containing sinter with 51.8 per cent of lead, plus several per cent for metallic lead from the windboxes, operations have been much smoother and the troubles from accretions have been much less. It is

(*Continued on page* 94)

Zinc Metallurgy

Conditions in domestic industry direct attention first to costs and later to production. Abroad war curtails information regarding current technological developments

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METALLURGY OF ZINC IN 1939 was influenced largely by economic conditions. During the first three quarters low prices and limited markets led to emphasis on cost and efficiency instead of capacity. Higher prices in the fourth quarter were a stimulus for increased rates of production. Owing to the unsettled situation abroad, news of developments in European zinc metallurgy is meager.

No new large-scale zinc mills nor smelters were placed in operation during the year.

Probably the outstanding milling achievement was the final development of a heavy liquid float-and-sink concentrating method to full commercial operation. According to Robert Ammon, chief metallurgist of the American Zinc, Lead & Smelting Company, the entire tonnage of the Mascot, Tenn., mines is being treated by the differential density process. Beginning in February, all jigs were abandoned and the flowsheet was simplified as follows: The minus $\frac{3}{8}$-in. round-hole undersize is separated, and the entire oversize is sent to the cone of the differential density plant, where 60 per cent of the entire mine tonnage is diverted as very low-grade tailings. Concentrates are scalped from the fines and from crushed differential density concentrates, with only flotation tailings wasted in addition to the differential density tailings. The operating costs equal those of jigging, and the mill recovery was raised from 89 to approximately 93 per cent.

The Eagle-Picher Lead Company continued to operate a similar differential density cone at Picher, Okla. Both plants use fine-ground galena as a suspension material to give the necessary specific gravity to the liquid suspensoid medium. It is probable that ferrosilicon, used for the same purpose in concentrating iron ores, will be tested in one of the zinc mills.

According to A. E. Wiggin, manager of reduction departments, the Anaconda Copper Mining Company has replaced its Brunton sampling mill at Anaconda with a so-called "belt" sample mill. In the Brunton mill it could sample only one-fifth and sometimes one-tenth of the cars. By segregating the ore it now samples at least 80 per cent of all ore from each mine. A revolving cutter takes a portion of the ore stream from the main belt leaving the crushing plant. At this point the ore is crushed to minus $\frac{3}{4}$ in. The sample is then reduced further by crushing and cutting. The new sampling mill is more efficient and has proved to cost less to operate.

Selective flotation of zinc ores has been pioneered by the Zinc Corporation at Broken Hill, Australia, since 1907. Originally operated as a lead mine, a large stock of oxidized zinc-bearing tailings was accumulated. Herbert Hoover visited Australia about 1905 and recommended the application of newly developed processes to the accumulated tailings dumps. Since then the Zinc Corporation has treated more than 3,500,000 tons of tailings and more than 6,000,000 tons of ore, producing well over 1,000,000 tons each of lead and zinc concentrates. Milling operations have progressed from the Elmore vacuum flotation cells to the Lyster machines and to the modern flotation cells of today.

The newly constructed mill at Broken Hill, completed in 1939, consists of three 12-cell primary lead flotation units, one 4-cell lead cleaner unit, three 12-cell primary zinc flotation units, and one 8-cell zinc cleaner unit. The recovery is approximately 96.4 per cent of lead in the lead concentrates, 93.5 per cent of the silver in the lead concentrates, and 87.5 per cent of the zinc in the zinc concentrates. Lead concentrates contain 77.3 per cent of lead, 18.9 oz. of silver per ton, and 3.6 per cent of zinc. Zinc concentrates contain 53.3 per cent of zinc, 1.3 per cent of lead, and 0.8 oz. of silver per ton. The mill feed averages 16 per cent of lead, 4 oz. of silver, and 11 per cent of zinc. Sodium ethyl xanthate and eucalyptus oil are used to float the lead-silver minerals, and zinc blende is subsequently recovered with copper sulphate, sodium Aerofloat, and additional eucalyptus oil.

Roasting of concentrates by the suspension roasting method at Trail, B. C., has proved most successful, according to B. A. Stimmel, superintendent of the zinc plant of the Consolidated Mining & Smelting Company of Canada. The suspension roasters, operating with the addition of by-product oxygen, are treating 145 to 190 tons of concentrates per 24 hours. The variation in tonnage is due to the different sizes of equipment, more especially the various sizes of cyclone dust collectors attached to each roaster. All roasters are supplied with steam boilers for gas-cooling purposes. The steam developed is 1.1 lb. of steam for each pound of concentrates treated.

The Josephtown (Pa.) smelter has shown a substantial increase in capacity of furnaces, according to G. R. Wheaton, manager of the zinc smelting division of the St. Joseph Lead Company.

The St. Joseph electrothermal distillation process, which for several years produced a high-grade zinc oxide, began in 1937 to produce high-grade zinc and has been in continuous operation for metal production since. Outstanding features of the process are the heating of a properly desulphurized and sized sintered charge by means of electrical resistance following a primary reduction step. Zinc vapor passes to a U-tube-type condenser containing molten zinc, which collects the vapor. The product is better than 99.96 per cent zinc.

Residues from distilling plants and other oxide-bearing materials are effectively treated in a Waelz kiln, where approximately 90 per cent of the zinc is recovered. The oxide concentrates, after conditioning, make excellent material for retort zinc production because of the lower tempera-

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ture required for distillation, and with consequent saving in refractories and higher zinc recovery.

The plant of the Giesche Spolka Akcyjna at Katowice, Poland, was unique among the intermittent distilling plants of the world in that there were in operation retort, electrolytic, and Waelz processes, coordinated for the highest obtainable metallurgic efficiency.

Horizontal-retort distilling plants continue to increase production per retort, both in the United States and in Europe. One European plant is producing over 100 lb. of metal per retort daily. An increase in density of charge, aided by sizing of sinter with reduction in fuel—particularly the diminishing of the percentage of fuel—are factors in obtaining greater weight of zinc per retort and an added extraction of zinc. European producers customarily use prolongs and larger retorts than American smelters.

The 28- or 32-hour period of retort firing has increased the useful life of refractories and extraction of zinc and has improved the labor problem as well, particularly for the longer firing period.

Continued demand for cadmium has influenced zinc metallurgy. Many retort plants recover cadmium from the flue dust and fines incidental to the zinc operation. Careful attention to the recovery of cadmium effectively diminishes the source of cadmium contamination in the zinc product and also supplies a valuable byproduct of the zinc smelter.

The success of non-electrolytic methods of cadmium recovery lies in the coordination of several physical and chemical steps, particularly in the great rapidity of precipitation of cadmium sponge in commercially pure form, from a sulphate solution flowing with suitable velocity in contact with zinc slabs.

Consumption of cadmium is increasing. Its status is closely associated with the automobile industry, in which it provides high-grade bearings demanded by present service. The fatigue life of Cd-Ag-Cu bearings is approximately three times that of the best available babbitt bearings. Plasticity of the Cd-Ag-Cu bearing is enough to permit bearings to accommodate shaft deflections without danger of seizure, and the toughness is adequate to avoid cracking out at the edges of the bearing.

Cadmium metal production for 1939 was approximately 4,000,000 lb. This quantity could be increased materially if there were a reasonable recovery of cadmium in the Tri-State concentrates, which in 1939 amounted to approximately 402,000 tons, containing about 0.38 per cent of cadmium. The potential supply of cadmium from this source, assuming 80 per cent recovery, would provide approximately 2,400,000 lb., or about 60 per cent of the probable cadmium production for 1939. Actually, very little of this quantity is recovered.

Indium was recovered experimentally in 1939 in the electrolytic byproduct cadmium plant.

The "New Jersey" continuous retort plant at Oker, Harz, Germany, with eight retorts in operation, was expected to have an additional unit completed during the year, which would double its capacity.

The zinc plant of the Sullivan Mining Company at Kellogg, Idaho, was in 1939 operated for the first time at the full capacity of its 450 cells, producing approximately 100 tons of zinc per day. According to W. A. Woolf, superintendent of the electrolytic plant, the company is steadily improving the purity of the zinc, which has been 99.99 per cent plus since 1929.

Lead containing about 1 per cent of silver has proved effective as an insoluble anode material which makes possible the production of extremely high-purity cathode zinc. The Consolidated Smelting & Refining Company has experimented with cast lead anodes coated with electrolytically deposited lead by the Betts process for the production of high-grade zinc cathodes.

Cerro de Pasco Copper Corporation has been contemplating an electrolytic zinc plant for some time and has reached the stage of experiment and study.

Rhodesian Broken Hill Development Company has developed a large deposit of zinc sulphide ore by drilling, and eventually the electrolytic practice now conforming to zinc silicate treatment may be changed to a simpler procedure.

During the development stage of the electrolytic process at Risdon, Tasmania, cobalt was considered a toxic impurity. Now cobalt in suitably controlled concentrations is found to stabilize the lead anodes and thereby make possible the production of cathode zinc containing a very small amount of lead.

Bethlehem Steel Corporation has added another unit to its electrogalvanizing unit at Sparrows Point, Md., for zinc coating of steel wire. This addition provides an output of 80 tons of coated steel wire per day. The new plant has two cells, each taking 40,000 amp., applied to 12 wires moving at 150 f.p.m. through the acid zinc sulphate solution. Great Britain has three plants of the same type.

A commercial plant for the production of zinc-coated steel sheets by the Bethanizing process has been built at Blasdell and was put into production in 1938.

Zinc of 99.99 per cent purity has been used largely in die castings and more recently in brass. W. M. Peirce, of the New Jersey Zinc Company, in the October issue of *Metal Progress,* concludes that there is nothing to be gained by increasing the purity of zinc above 99.99 per cent and that in hot-galvanizing and in electrogalvanizing the 99.99 per cent zinc is superior to 99.94 per cent zinc only in special instances. He states that many believe a new and rapidly expanding use of zinc will be as zinc-dust paint for metal protection. Extensive testing programs over a number of years have led to the conclusion that zinc-dust paints, particularly when mixed with zinc oxide and iron oxide, are unequaled as primary coats next to steel, and for many types of service they are excellent finish coats.

A large tonnage of 99.99 per cent zinc was used in the production of French process oxide.

Bright zinc plating is an active consumer of high-grade zinc, but is meeting competition from cadmium.

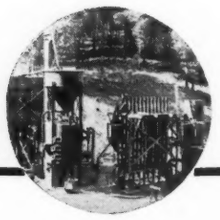
Efforts by research and development of the zinc industry through the American Zinc Institute and other agencies to convince the galvanizing industry and the public of the desirability of uniform heavy coatings in hot-dip galvanizing is meeting with success, and the reliability of zinc as a protective coating is regaining its rightful place in the sun.

MINERAL DRESSING

(*Continued from page* 83)

dustry. Numerous ceramic raw materials, such as feldspar, quartz, clay, talc, nephelite, and spodumene, may be beneficiated. The cationic reagents, such as the substituted ammonium compounds and nitrogen bases, are especially useful in filming acid minerals selectively. A great variety of mineral aggregates now may be studied by flotation methods with reasonable assurance that a successful method of dressing may be forthcoming. A factor always to be considered is pH control, and slime removal by washing is often a prerequisite to successful use of flotation reagents.

The non-floatability of fine particles (below about 10 microns) still challenges the metallurgist, and the latest published research on this phase of flotation is in Japanese (Chemical Abstracts, Vol. 33, p. 9221, 1939). In the study of galena, chalcopyrite, and pyrite, it is recorded that floatabilities of these minerals were about 95 per cent at 50-10 μ; it decreased at less than 10 μ and decreased further at less than 5 μ. The reagents used were potassium, ethyl xanthate, and camphor white oil.



The Uncommon Metals

Lanthanum, prepared by electrolyzing its fused chloride, is latest addition to list of those seeking market. Progress in reduction and use of various others is recorded

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THE LESS COMMON METALS have received increasing attention in the past year from both laboratory and large-scale technologists. The main stimulus for this new interest has come from the realization that many metals of this group are uncommon, not because of rare occurrence in nature but because of the difficult metallurgical problems involved in their reduction and the disappointing properties of the impure metals obtained by older reduction processes. Reduction difficulties have been conquered gradually, but improvement in the unworkable nature of the resultant metals, which was hardly considered a possibility a few years ago, has been obtained for a number of metals.

MANGANESE—The electrolytic production of metallic manganese announced two years ago by the Bureau of Mines has been improved, and commercial production was begun at Knoxville, Tenn., by the Electro Manganese Corporation. The Knoxville plant has been described by Hammerquist.[1] The latest developments of the process and the properties of many of the alloys made from electrolytic manganese have been described by Dean[2] and his associates.

According to these investigators, manganese alloys with a few per cent of copper and nickel are ductile and may be rolled or drawn. With suitable heat-treatment they develop exceptionally high vibration damping capacity and electrical resistance. A marked difference is also reported in the properties of high zinc and aluminum alloys when made with electrolytic instead of aluminothermic manganese.

Dean and Anderson[3] have reported alloys of the pseudobinary system Cu-Mn-Ni as having an exceptional range of hardening by heat. Kroll,[4] using double-distilled manganese, has confirmed the properties of some of the alloys made with electrolytic manganese.

It may be noted in passing that another uncommon metal, cobalt, is produced as a byproduct of electrolytic manganese manufacture, inasmuch as nearly all manganese ores contain from a few hundredths to a few tenths of a per cent of cobalt.

TITANIUM AND ZIRCONIUM—Titanium is one of the most plentiful of the elements and is 60 to 70 times more abundant than copper. For its manifold industrial uses a correlated abstract by Comstock (*Metals and Alloys,* October and November, 1938) may be consulted. Its interest here is that it was one of the first typically brittle metals to be obtained in a ductile form and thus to indicate that brittleness is not necessarily an inherent property of the metal itself and disappears when minute quantities of impurities are removed. A recent study showed that oxide films at the grain boundaries were responsible for the brittleness of ordinary titanium. Reduction by calcium shavings or by calcium hydride gives a powder that when sintered may be hot-rolled into sheet. Unfortunately, the metal could not be melted, because molten titanium reacts with all crucible materials.

Titanium is really one of the light metals, having a specific gravity of 4.0. Its high melting point suggests that ductile alloys high in titanium would rate very high in ratio of strength and stiffness to weight.

Pilling and Talbot[5] have described dispersion hardening of alloys of iron, nickel, and titanium. The hardening of alloys of the Invar type having very low temperature coefficient by a compound of titanium and nickel promises to be of commercial importance. McKenna[6] has described a new hard compound of titanium with tungsten or tantalum and carbon made by reaction of the components in molten nickel and the subsequent removal of the nickel by a solvent.

Zirconium also has been obtained in ductile form recently and is now on the market as sheet, wire, or foil, and as a number of alloys, the most interesting of which is a master copper alloy (14-16 per cent Zr), used to increase the strength of copper with a minimum loss in electrical conductivity.

MAGNESIUM AND BARIUM—Haughton[7] has described the recent developments of magnesium metallurgy in Great Britain. The alloys of magnesium with Cu and Ag and with Ce appear to have considerably improved properties. Barium is being produced by the reduction of the oxide with aluminum and distillation of the barium. This barium is used to make barium-copper alloys for use as electron emitters.

CALCIUM—This is an uncommon metal that is attaining metallurgical importance, with applications too varied to list here. (See the correlated abstract by C. K. Mantell and Charles Hardy, *Metals and Alloys,* February and March, 1939.) According to *The Mining Journal,* London (p. 789, Aug. 26, 1939), metallic calcium is produced only in one German and one French plant, but the bulk of their outputs is used in the United States. The patent literature gives indications that American production of calcium is under consideration.

COLUMBIUM AND TANTALUM—No recent technologic advances can be reported for these two uncommon metals, which are appearing in new applications almost daily. Because of its great resistance to corrosion, tantalum apparatus is becoming standard equipment in plants handling corrosive liquids, and now an electrical immersion heater made of tantalum is available for use in pickling baths.

CHROMIUM AND BORON—A number of processes have been proposed for the emergency production of metallic chromium from domestic ores; the most novel of these is the Federal Bureau of Mines low-temperature reduction of chromic chloride to produce a sponge chromium of high

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grade. Pilot-plant test of the process is still lacking to determine whether the promising results obtained in the laboratory can be translated to an economically justified process.

The new product, Colmonoy, which has just appeared on the market in the form of four alloys to be used in protecting wearing parts, consists of hard, diamondlike crystals of chromium boride.

CADMIUM, GALLIUM, and INDIUM—These uncommon metals are recovered from operations connected with the metallurgy of zinc. Cadmium from the anode slimes in electrolytic zinc refining has found extensive applications, and the growing demand has resulted in much work and many patents for roasting zinc ores in such a way as to recover the greatest possible yield of cadmium from flue dust. Alador Por, in his paper on "Thirty Years of Zinc Blende Roasting," (*The Mining Journal*, London, Aug. 26, 1939), states that the Selaigneux process of caking a preroasted blende by the addition of 44 deg. Bé. sulphuric acid and roasting on a modified Dwight and Lloyd machine is the only one that volatilizes almost 100 per cent of the cadmium and 60-80 per cent of the lead.

Gallium and indium also are concentrated in the flue dust from zinc plants, but seldom are recovered, because of the lack of a market. The world's annual production of gallium is 110 lb. at $4 a gram, all recovered by one German plant, and used for making mirrors, quartz thermometers for temperatures up to 1,000 deg. C., dentists' amalgam, and ultra-violet lamps. For indium, various applications have been proposed, including a dental alloy, a constituent of bearing metal, and as plating; in all of these uses the behavior of indium is advantageous, but its price is still too high.

ANTIMONY—As is well known, a smelter at Laredo, Tex., handles Mexican and South American antimony ores. The American Smelting & Refining Company is said to be considering the production of antimony at its Perth Amboy plant. A new source of the metal is the concentrate, consisting chiefly of the rare mineral livingstonite ($HgS.2Sb_2S_3$) from a deposit in the Huitzuco district of Mexico. The concentrate analyzes: mercury, 7.73 per cent; antimony, 26.40; sulphur, 29.68; iron, 1.20; lime, 11.50; magnesia, 7.25; silica, 1.63; and alumina, 0.65 per cent. In 1938 this concentrate yielded about ½ ton of mercury and 1¾ tons of antimony daily. The antimony metal is marketed in three grades, as follows: "C" brand, 99.0 per cent Sb; "M" brand, 99.5 per cent Sb; and "M" Special, 99.8 per cent Sb, the last named showing not more than 0.05 per cent lead or other metals. The flowsheet for this novel plant, situated in Los Angeles, may be found in a paper by H. B. Menardi, A.I.M.E., T.P. 1040 (February, 1939). Political and labor disturbances in Mexico are interfering with production, and the Menardi plant is said to be experimenting with various domestic antimony ores that occur in the Western States. The Federal Bureau of Mines has investigated the possibility of recovering the antimony as well as the precious metal content of Valley County, Idaho, ores by an electrolytic method, but this process has not yet gone beyond the laboratory stage.

The smelter at Trail, B. C., began last year to market antimony metal recovered from the anode slimes of its electrolytic lead refinery. No details are available, but it is understood that the production is of the order of 4 tons a day.

BISMUTH—Most of the bismuth recovered from lead is used for making pharmaceuticals, but the Ekko process evolved by the United States Rubber Company, of Detroit, for electroforming with iron may provide a future outlet for bismuth in the form of "cerrobase," a nonshrinking Bi-Pb alloy of melting point 255 deg. C., patented by the Cerro de Pasco Copper Corporation. One application of the Ekko process is the production of dies or molds in which a photographic likeness can be transferred to iron.

MOLYBDENUM—One of the advantages of molybdenum over tungsten in ferro-alloys has been the fact that tungsten alloys required the tungsten to be in the metallic state for alloying, whereas oxidized molybdenum could be added unreduced, say as calcium molybdate. Now comes the announcement that in molybdenum steels the alloy is being added in the form of molybdenum sulphide, with beneficial results from a machining standpoint. Thus far no sacrifice of essential physical properties has been noted as a result of this deliberate contamination with sulphur.

From among the host of new products involving molybdenum, the most striking is undoubtedly Dupont's moly-black electroplating finish, which consists in plating molybdenum-nickel over an undercoating of cadmium. A coating of 0.001 in. may be applied 20 times more rapidly than nickel alone and is a true black optically.

American copper mills have of late developed methods for recovering molybdenum as a byproduct. From an interesting description of the technical details of such a process ("Chino Today," by John B. Huttl, *E.&M.J.*, Vol. 140, September, 1939, p. 29) the following typical result may be quoted: ". . . The original copper concentrate contains 30 per cent copper and 0.5 per cent MoS_2; the tailings, 30 per cent copper and 0.06 per cent MoS_2; and the molybdenite concentrate is over 85 per cent with copper less than 1 per cent."

SELENIUM and TELLURIUM—New uses of tellurium include those of hardener of lead and for improving creep strength and work-hardening properties of tin. An odd application of tellurium is in rubber hose and cable covering, where it increases toughness and resistance to abrasion. Latest improvements in the technology of the recovery of selenium and tellurium from copper-refining slimes are described by C. W. Clark and J. H. Schloen (A.I.M.E., T.P. 982, October, 1938). It is reported that the Boliden plant, in Sweden, has started recovering Se from its large arsenic production.

ARSENIC—The arsenic collecting in the flue dusts from the treatment of complex ores goes chiefly into the manufacture of agricultural arsenical sprays. Its use as a metallic constituent of alloys is almost negligible, although the past two years have seen some attempts at improving the properties of several metals by alloying with small quantities of arsenic, but with questionable success. The main metallurgical problem presented by arsenic is still the settling of the arsenical flue dusts from the roasting of high-arsenic complex ores. Thus far, concentrated sulphuric acid vapor is the only agent found effective in preventing the clogging of electrical precipitators by arsenic oxide.

LANTHANUM—The latest addition to the list of uncommon metals seeking a market is lanthanum. In working up monazite sands for cerium and thorium compounds, there is an accumulation of lanthanum oxide, for which no use has been found. Weibke (*Zeit. f. Elektrochemie*, July, 1939) shows how the metal may be prepared by electrolysis of its fused chloride, and he proposes to use the product of electrolysis for hardening aluminum and magnesium alloys.

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[1] *Steel*, October 1939.

[2] "Electrolytic Manganese and Its Alloys," by R. S. Dean. *Metal Progress*, October, 1939, p. 357. Also, "Manganese and Its Alloys," by Dean, Anderson, Ambrose, and Moss. U. S. Bureau of Mines Report of Investigation, No. 3477, November, 1939.

[3] R. S. Dean and C. T. Anderson. Discussion of paper by D. K. Crampton on "Age-Hardening Copper Alloys" at Metals Congress, Chicago, October, 1939.

[4] W. Kroll: "Hot Workable Manganese and Its Workable Alloys." Z. Metallk, Vol. 31, pp. 20–23 (1939).

[5] "Dispersion Hardening Alloys of Nickel and Iron, Nickel and Titanium," by N. B. Pilling and A. M. Talbot. Symposium on Dispersion Hardening, Metals Congress, Chicago, October, 1939.

[6] *Metals Progress*, August, 1939.

[7] J. L. Haughton: *Jour. Ind. Eng. Chem.*, August, 1939.

LEAD METALLURGY

(*Continued from page 89*)

understood that not enough charge has been available to determine the maximum furnace capacity.

The technique of shutting down and starting up blast furnaces has been so perfected that there is not much loss of capacity per operating hour, and only a few extra charges of coke are consumed. The chief methods employed to keep the furnace hot during "shut downs" of several days are to add a few charges of coke, after running down the furnace column before shutting down; then to seal the top of the furnace with as fine charge as is available (for example, fine slag). Hot water is circulated through the jackets, perhaps by using a centrifugal pump. But few extra coke or slag charges are needed in starting up a furnace prepared as indicated.

The trend to reduce refinery costs by "roughing out" all impurities possible from the crude bullion may be seen more clearly by considering operations over a period of years. Those familiar with earlier figures will be interested in the purity of the bullion now shipped to refineries from "rough-drossing" plants. For instance, a lead plant receiving large amounts of copper, arsenic, antimony, and bismuth shipped drossed bullion containing on the average, in per cent, the following: Cu 0.01, As 0.01, Sb 1.0, Bi 0.01.

Some plants treating products containing both copper and lead are cutting down on the load of arsenic circulating between copper and lead units. The lead smelter may remove arsenic "on both sides"; for example, it may roast in hearths the leady Cottrell dust received from copper converters and also the copper-lead matte and speiss drossed off at the lead smelter itself. The arsenic may also be roasted out of the cadmium dust accumulated from several recirculations through the blast furnace. The lead blast furnace can be so operated that the antimony stays with the lead bullion.

Still another job assumed by some lead smelters to help the refineries is to segregate the bismuth ores and to treat or smelt them separately so as to leave the main bulk of the lead made virtually bismuth free, or under some set specifications. Thus most of the lead may be fire-refined without using calcium, etc., to collect the bismuth, and the bismuth-rich product treated by some other process.

An example of thus segregating the bismuth is given in the outstanding publication on lead for the year—the development of the Bunker Hill enterprises as recorded in the August, 1939, issue of this magazine. The "silver belt" in the Coeur d'Alenes has developed large tonnages of silver ores containing copper, antimony, arsenic, bismuth, and lead. The concentrates received are reconcentrated to give two products—one rich in silver, copper, antimony, arsenic, and bismuth, and the other poor, containing much iron for the regular lead-smelting operation. The richer product is roasted in a Herreshoff provided with a separate baghouse for the dust formed. The calcine is smelted directly in a reverberatory with silica, litharge, and coke breeze to produce a bullion containing 85 per cent of the silver and 90 per cent of the bismuth. This bullion is cupeled directly to produce a segregated bismuth-rich litharge and Doré, which is refined in a Monarch furnace.

Another plant segregates the bismuth-rich lead by smelting separately the bismuth-rich products received and flue dust made therefrom. Very careful clean-ups are necessary before beginning a "regular lead" campaign. This bismuth-rich lead is reported to be treated by an electrolytic process.

SULPHUR RECOVERY — R. E. Swain offers a few notes on the manufacture of elemental sulphur from waste smelter gases at Trail in *Ind. & Eng. Chem.*, Vol. 31, p. 1358, November, 1939. A rough outline is given of the experimental work at Garfield. Where the market for liquid SO_2 is small—for example, the market is over 400 or 500 miles distant—it is thought that under some conditions natural gas may be used as a reducer in place of coke to make elemental sulphur.

At Trail some cooperative work was carried out with the Bureau of Mines to establish the technique of so sintering lead ores that the SO_2 gas evolved would be rich enough to absorb readily. This work is to be published soon. The sulphur plant at Trail continued to operate throughout the year, its operation being so coordinated with that of the smelter as to keep to a minimum the SO_2 content of the gases crossing the international border.

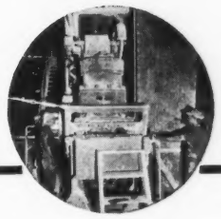
As an addition to these gradual improvements in technique to fit economic and industrial conditions, one more radical innovation may be noted that is reported to have been carried to a "semicommercial scale." The development is of particular interest to those wishing to treat very rich galena concentrates in a district where it is difficult to dispose of any SO_2 evolved. Ellingham writes (*Trans.* Inst. Chem. Eng., London, Vol. 16, 1938, p. 77) on the electrolysis of dried galena in a fused bath of $PbCl_2$, using graphite electrodes. The sulphur vapor is drawn off to a condenser and the molten lead containing Bi, Sb, and Ag through a siphon. The minerals insoluble in the electrolyte, such as silicates and sphalerite, are skimmed from the surface of the bath. The bullion made analyzed 99.93 per cent lead.

LEAD ALLOYS—Some of the alloys developed in the laboratory became in 1939 available in large commercial quantities. Ledloy steel is now being fabricated by Bethlehem, Bliss & Laughlin, and other companies besides Inland, to fit the standard S.A.E. qualifications. Experimentation has shown that the extra machinability obtained by the use of a small amount of lead was not obtained at the expense of other desirable properties.

Steel-backed, lead bronze bearings found favor in high-speed motors, and 20 to 30 per cent lead-copper bearings for moderately stressed applications. Sn and Mn additions enable lead to stand higher stresses. Electrolytic deposition of 3 to 5 per cent lead-silver alloys was found (*Trans.* Electrochem. Soc. Vol. 65, p. 185) to produce a well-bonded bearing liner. Cerro de Pasco came into the market with Cerromatrix alloy of Bi-Pb-Sn-Sb for mounting dies and punches. More experimental work was reported on the use of tellurium and calcium with lead, tellurium having been found to increase the work-hardening ability.

Ca was found to increase the fatigue resistance, tensile strength, and hardness of lead, to increase these properties faster, and to require smaller amounts than Sb. In general, lead alloys with the highest hardness were said to show the least creep. Mantell and Hardy prepared an abstract on Ca-Pb alloys for *Metals and Alloys*. Some experiments on lead segregations in nickel bronzes indicated that those responding best to conditions of good lubrication contained 5 to 6 per cent Sn, 4 to 5 per cent Ni, and 32 to 35 per cent Pb. Lead powder became available in larger amounts for use with other powders, as copper, to make pressed bearings that are easily lubricated; alloys can thus be made from powdered metals that are immiscible or difficultly miscible in the liquid state.

Germany is now trying to substitute lead for tin-bearing metals and in turn aluminum for lead in cable sheathing, so as to use only the metals produced in controlled districts. The earth metals, such as magnesium, calcium, and aluminum, are being used as rapidly as they can be adapted as substitutes for less abundant metals.



Industrial Minerals

Activity in general good, but increase in demand fails to bring rise in prices. Advent of war finds country well supplied with most commodities of this class, particularly potash

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A STRANGE PHENOMENON was witnessed in the field of industrial minerals during 1939. With few exceptions a substantial increase in demand has brought about little change in price levels. Although producers seem reluctant to comment, it is generally believed that the attitude of the Washington Administration toward price increases has prevented a normal reaction of supply and demand. The advent of another European war has found the United States more self-sufficient in some materials. Potash and magnesite are two of these.

The war was not entirely unheralded, as in 1914, and a year or more of uncertainty has enabled some industries to accumulate supplies larger than normal. Such is the situation in those grades of chromite used in the chemical and refractory trades. There is, however, a shortage in mica, and the supply of manganese which is used in part as a non-metallic is inadequate.

Industrial mineral producers, though admitting that forecasts are difficult and that the future is clouded with uncertainty, generally expect 1940 to be a period of active production, with prices firm but with little change.

ANDALUSITE, SILLIMANITE—Increased activity in certain of the electrical industries resulted in the reopening of the Champion Sillimanite Company's mine near Lovelock, Nev., as well as that near Bishop, Cal., in 1939. Shipments from Bishop were approximately 2,000 tons. At American Canyon, Nev., the Stockton Firebrick Company is mining sericite containing small amounts of alumino-silicates which revert to mullite at relatively low temperatures. The product is shipped to Pittsburg, Cal., for making firebrick.

ASBESTOS—Operations were at capacity through the year, although prices failed to rise as an accompaniment. A 10 per cent increase is expected from Jan. 1, and the outlook is for continued activity. The war has diverted output formerly shipped by Canadian mines to Germany and some other European nations. This is now largely absorbed by South America, Australia, and the Orient. Shipments to the United States increased in the latter part of the twelve-month period.

The chief technical development was the adoption of underground mining methods by two additional mines, the Bell Asbestos Mines, Ltd., and the Johnson's Company. Block caving is being planned like that at the Kings mine. Asbestos Corporation, Ltd., has changed its Kings concentrator from a single- to a two-unit plant, treating 400 tons per hour.

BARITE—Interruption of foreign shipping has been of benefit to Eastern barite producers. Mines of northern Georgia were particularly active. Some increase in production also took place in central Missouri, but this was probably offset by reduced operations in the southern part of the State. Active development and production are reported in Nevada. Prices have changed little.

BENTONITE — The most important current development is the discovery that the calcium bentonites of Alabama and Mississippi are particularly useful in synthetic molding sand applied to small and medium-sized castings. Three plants have been placed in operation in this area. Systematic research continues to extend the markets for both sodium and calcium bentonites. Increased operations have not been attended by price increases.

BORAX—Consumption of borax was substantially greater in 1939 than during the previous years. The long-lasting increased demand, particularly during the past ten years, is attributed to the general adoption of its use in glassware. It is now used by every important glass manufacturer in the United States and by most European concerns.

The importance of borax in plant growth and health is realized increasingly. Soil deficient in borax is the cause of various plant diseases, and many fertilizer mixes now include the substance.

CHROMITE — Under its appropriations for developing deficient strategic minerals, the Bureau of Mines is opening up reserves of chromite in Montana and other Western States. Prices of imported chrome have advanced substantially. Some foreign countries have imposed restrictions on the export of ore, and the difficulty of securing ships with attendant war-risk insurance indicates existence of a growing problem of securing foreign supplies, particularly from Turkey, New Caledonia, and South Africa. United States government purchases for stockpile requirements have created further shortage of supplies for current consumption. There are, however, substantial stocks in consumers' hands.

CRUSHED STONE—War conditions, though having little effect on the demand for building and road stone, have increased the demand for fluxing stone. Prices remained substantially unchanged, although a slight decrease was noted in some places. The practice of washing crushed stone is being extended to meet more rigid specifications.

DIAMONDS — Output in 1939 has been estimated at 11,000,000 carats, worth about $40,000,000. The volume is about equal to that of 1938, but the value somewhat less due to a larger amount of "common goods." Prices were, however, slightly firmer. Continuation of the war is expected to increase the demand for industrial stones, a scarcity being already reported in the better grades.

FELDSPAR—Though study of beneficiation methods has continued, there were no concrete developments in 1939. Elimination of the competition

from pottery plants in Czechoslovakia has produced increased domestic domestic business for American potteries, and this has resulted in a larger demand for domestic feldspar. Consumption for 1939 is believed to have been around 250,000 tons, compared to 214,514 tons in 1938. A slight upward tendency in prices was interrupted during the latter part of the year by threats of a price war.

LIME — No new technical developments were reported. Though a few decreases in price were noted in some localities, on the whole there has been little change. Building and agricultural consumption remained steady, but the demand for steel and chemical lime brought increased output during the latter months.

MAGNESITE—Except for the production of synthetic magnesite from sea water near Redwood City, Calif., magnesite production in the United States is now controlled by the Northwest Magnesite Company, at Chewelah, Wash., a subsidiary of Harbison-Walker Refractories Company and General Refractories Company. It now employs about 450 men, having added substantially to its force. Shipments from Europe have been discontinued and supplies from the Orient are not yet substantial. Nippon Industrial Company has, however, continued the development of deposits in Korea and Manchukuo, and is reported to be operating three calcining plants. Ultimately this company may supply an important part of the world requirements.

MICA — The outbreak of war in Europe precipitated a scramble for supplies, and this, together with high war-risk insurance and freights, resulted in sudden price increases in certain grades. Cigarette mica rose about 50 per cent. Reduced imports from India and a lower freight rate to the Eastern seaboard have stimulated the output of block and scrap from the Black Hills of South Dakota.

Use of colloidal bentonite to produce "Alsifilm" as a mica substitute is still in the experimental stage. The chief development in this direction during 1939 was the treatment with caustic potash to modify the bentonite molecule so as to approach that of muscovite.

PORTLAND CEMENT — Technical progress in this field has been largely in the direction of the beneficiation of cement raw materials. An outstanding accomplishment in this direction is the use of so-called "positive ion" or "cationic" reagents for the removal of mica from argillaceous limestone at the plant of the Valley Forge Cement Company in Pennsylvania. This step is in addition to the concentration of calcite by flotation. Its object is to reduce the proportion of alumina, alkalies, and magnesia.

The A.S.T.M. will probably adopt new cement specifications in 1940, covering five distinct types of portland cement to meet specific uses, and these are expected to replace general specifications heretofore in use. The five types are: (1), Where special properties of types 2, 3, 4, and 5 are not necessary; (2), For use in concrete exposed to the weather or for moderate sulphate resistance or for moderate freezing or thawing; (3), High early-strength cement; (4), Low-heat cement; (5), Sulphate resistant cement. Adoption of such specifications is expected to increase the cost of production and greatly curtail plant capacity. It will also require closer selection of raw materials and more extensive use of beneficiation.

Production in 1939 is believed to have exceeded that of 1938 by about 16 per cent. Only minor price changes have taken place, the trend having been slightly upward.

POTASH—At the outbreak of war in 1914, the United States was almost wholly dependent on Germany for its potash supplies. Domestic capacity in 1939 has been estimated at 540,000 tons, against domestic consumption in 1938 of 467,000 tons. International Agricultural Corporation expects to begin production of sulphate from its New Mexico deposits in 1940. Though two other domestic concerns started producing sulphate in 1939, a shortage for 1940 spring planting is expected.

Although prices have remained unchanged, those who contracted for European potash at contract discounts will apparently lose such discounts and will be compelled to buy interim supplies at relatively higher open-market prices.

SULPHUR—The employment of sulphuric acid as a catalytic agent in the production of alkylation fuel is expected to regain the ground lost to the sulphur industry by the adoption, in 1932, of solvent refining methods. Production of synthetic salt cake was undertaken by the Matheson Alkali Company. In this, soda ash and sulphur are sintered together.

Though the demand increased vigorously during the last quarter, due in part to restriction on shipments imposed by Italy, the price of American sulphur remained unchanged at $16 per ton f.o.b. mines.

BAUXITE — War in Europe has caused only minor distortion in the production of bauxite, the country chiefly affected being Germany. Waterborne shipments could not reach Germany after Sept. 1, after which date Germany had to rely on Hungary and the Balkan countries for its supply. It is reported that production in those countries has been speeded up, although stocks in Germany are believed to have been substantial.

Output from the Dutch East Indies was increased in 1939, shipments being chiefly to Japan and Germany. Production from Dutch Guiana is largely shipped to the United States; that from British Guiana is exported to Canada.

No marked price changes took place in 1939, but 1940 prices are expected to be somewhat higher.

The only new development during the year of importance was the commencing of operations at Lippe of the new plant of Vereinigte Aluminiumwerke, to produce alumina from clay.

FLUORSPAR—Because of the greatly increased operations in the steel industry, production schedules at most domestic mines were substantially greater during the last half of the year, and 1939 total production is expected to exceed that of 1938.

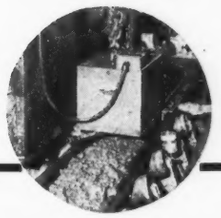
The price of Illinois-Kentucky gravel fluorspar was $20 per short ton, rail shipment, at the beginning of the year. This dropped to $17 in April, but gradually regained ground and quotations were at $22 the latter part of 1939. Imports during 1939 exceeded those of 1938 by a substantial amount.

CANADA

(*Continued from page* 63)

to 67. An increase in dividend rate was made by 22 mines, 13 were lower, and the others unchanged from the previous year. The total disbursement to shareholders of 67 companies in 1939 was $100,953,853, compared with $95,481,097 paid by 58 gold and base-metal operators in 1938.

The general outlook for mining in 1940 is more favorable than for several years, at least for those properties that have passed the stage of mill construction. The chances are less encouraging for non-producers and exploration companies, with indications that the trend of the last three years will continue. Mining is now obligated to play an essential part in Canada's war effort and in every respect the industry is prepared to do an efficient job. With ore reserves and a diversity of mineral resources far in advance of 1914 conditions, the mineral industries have also a trained personnel and metallurgical and other technical equipment equal to any demands. Being soundly established to meet the emergency of war, Canadian mining will be in a position to expand rapidly when a normal economy is restored.



1939 Equipment

Trend toward mechanizing underground operations in precious- and base-metal mines gained wider attention during the year as machinery of this type meets the requirements of hard-rock mining

H. C. CHELLSON

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VIEWING THE PROGRESS achieved each year by manufacturers of equipment for the metal-mining industry, there is found a growing desire among mine operators to study and consider the technique of mechanized equipment. Some important reasons for this trend are higher taxes, increased operating costs, shorter working hours, deeper mining, and the desire of the industry to be prepared to compete with foreign low-cost metal producers who are sending metals, particularly zinc, into this country under a lower tariff, in order to obtain badly needed foreign exchange. The future influence of the present European war on the domestic precious- and base-metal mining industry is unpredictable, but in Canada, Africa and other countries mechanized mining equipment is now in demand to speed up production of all metals for defense purposes.

During 1939 manufacturers made greater use of new alloys in many of their products which are meeting the rigorous requirements and approval of the metal mining industry. A brief summary of the progressive record for 1939 follows:

ROCK DRILLS — Performance of modern rock drills advance steadily as refinements in design and greater use of new alloys in their manufacture attract the attention of mine operators. Drill manufacturers not only improved their equipment in this direction but also satisfied certain state requirements aimed at the silicosis hazard. During 1939 the following drill manufacturers equipped their drills for use in New York State with a new combination air throttle and water valve: Chicago Pneumatic Tool Company, Cleveland Rock Drill Company, Gardner Denver Company, Independent Pneumatic Tool Company, Ingersoll-Rand Company, Sullivan Machinery Company, and Worthington Pump & Machinery Corporation. Features of this valve are that the required rate of water flow through the drill steel will be insured whenever the air throttle is in the operating positions, half speed as well as full speed. This valve prevents the drill operator from drilling dry. Among new drills announced during 1939, the Independent Pneumatic Tool Company offered its 100B drifter featuring the manufacturer's short-travel valve and a new Thor power feed. A new drill by the Sullivan Machinery Company is its self-rotating S-91 dual valve stoper weighing around 90 lb. for use in raises and general stoping purposes. Refinements were made and sizes added to the company's self-supporting "Safe-T-Stoper," which was announced in 1938. Gardner-Denver Company introduced its new R-104 self-rotating stoper. Improved valve action was placed in the company's 14F-89 H and D-89 BH drills of automatic and crank-feed types respectively. From Camborne, England, Holman Bros., Ltd., announced their new Silver Bullet stoper, available with standard or reverse feed.

DETACHABLE BITS — These important rock-drilling units continue to gain in popularity, and during 1939 progress was made in resharpening and heat-treating, so that lower unit cost is in prospect for users of detachable bits. The Mine & Smelter Supply Company announced its Hot Miller, wherein the bits are heated to 1,650 deg. F. and the bit flutes are milled out hot, with a hot milling cutter, thus sharpening the bit. Ingersoll-Rand announced two machines for reconditioning their detachable Jackbits, known as the Jackmill. These hot-milling machines are electric motor equipped and are designated the JMA and JMB, with a capacity of redressing 180 and 90 Jackbits per machine respectively per hour. A new non-automatic Jackbit grinder the J-3 and the company's new semi-automatic Jackbit grinder, the J-5, were also brought out.

DIAMOND DRILLING—After years of intensive experimental work, Holman Bros., Camborne, England, announced an air-driven rotary rock-boring machine — the Roto-Driller— which takes advantage of the high speeds made possible by the modern diamond crown bit. Their Model D drills holes up to 1 9/16 in. diameter in any direction to depth of over 120 ft. C. Kirk Hillman Company, Seattle, Wash., brought out a new drill called the "Prospector," particularly adapted to mineral prospecting. Sprague & Henwood, Inc., Scranton, Pa., report research and experimental work having for their objectives improvements to cast set Bortz diamond bits and note the trend in drilling practise toward perfecting equipment that will permit economical use of diamond drills for drilling short blast holes. Sullivan Machinery Company, Michigan City, Ind., made electric motor power optional for the company's No. 6 Turbinair drill and its No. 12 core drill.

EXPLOSIVES—A new blasting agent for seismic prospecting, known as Nitramon S, was introduced by E. I. du Pont de Nemours & Company during 1939. This blasting agent is said to be much safer to handle and use than gelatin dynamites for reflection shooting. An improvement in safer blasting technique was offered by the Ensign-Bickford Company, Simsbury, Conn. in its Master fuse-lighter for rotation firing of drill holes.

MINE-CAR LOADERS — Equipment of this type is demonstrating the fact that impressive gains are being made in mechanizing metal mining and tunneling practices. This type of mechanized digging unit is also being employed in small mines and has been found advantageous in reducing operating costs. Mechanical car loading and other mechanized types of rock-handling devices are attracting the study of mine operators everywhere. The Eimco Corporation, Salt Lake City, added the Model 12 B and Model 21 Eimco-Finlay Loader to its line in 1939. These new units, with bucket capacities (water measure) of 5½ and 9 cu.ft. respectively, are said to have more speed developed by the especially designed bucket elevating motors. Sullivan Machinery Company, Michigan City, Ind., announced many operating improvements to its line of mine-car

loaders, such as the curved rocker-arm track, which allows loading of unusually high mine cars without changing the rocker arms. Evidence of the broadening trend in mechanical loading is reported by the Myers-Whaley Company, Knoxville, Tenn., whose automatic coal-loading machine last year proved equally effective in loading 360 tons of limestone per machine shift from a 5-ft. seam. Goodman Manufacturing Company, Chicago, Ill., reported a new 360 Goodman track-mounted mobile loader with increased capacity and lower height than Type 260. The Goodman auto-feed duckbill loading head for use with shaker conveyors emerged as a successful piece of working equipment in 1939.

ORE HAULAGE — As the trend toward "streamlined" mining operations advances, larger mine cars are in demand. They must withstand rough treatment and corrosion and still be easy to handle. Among large capacity ore-car manufacturers, the Pressed Steel Car Company, Pittsburgh, is furnishing the Utah Copper Company with 200 ore cars made of Cumoloy steel, each car having a capacity of 100 tons. The Atlas Car & Manufacturing Company, Cleveland, Ohio, introduced new designs for its mining locomotives and made improvements in its battery boxes of locomotives used in hazardous service. A new 2½-ton mine locomotive having totally inclosed spur gears running in an oil bath was also brought out by the company. The Jeffrey Manufacturing Company, Columbus, Ohio, introduced a reversing type controller designed to facilitate handling a locomotive that requires frequent reversals, as spotting cars behind loading machines. The company also developed a hydraulic brake for mine locomotives. Modernistic design was an attractive feature of a new high-speed electric mine locomotive by the Differential Steel Car Company, Findlay, Ohio. Gould Storage Battery Corporation, Depew, N. Y., designed a new 48-cell battery for the propulsion of a new Joy shuttle car that is finding wider acceptance in mechanized mining. The growing use of diesel switching locomotives has attracted the interest of the Baldwin Locomotive Works, Eddystone, Pa., which recently announced construction of a 660-hp. and a 1,000-hp. diesel switching locomotive.

Ohio Brass Company, Mansfield, Ohio, anticipating the spread of mechanized mining, has developed electrical devices that keep pace with this progress. The company's Type B junction box accommodating three circuits is said to prohibit making electrical connections when the current is on. Offering connection ease, and safety to cable-reel equipped mining machines and gathering locomotives, the company developed its Type G new fused trolley tap arrangement. A colored button reflector switch signal was designed by the Portable Lamp & Equipment Company, Pittsburgh, Pa., for simple mounting on a rail tie.

Another device of growing interest to mine operators is the improved car transfer by the American Mine Door Company, Canton, Ohio, that makes possible transferring one or more cars on a single track, thereby simplifying the technique of loading a train of cars from a tunnel face, drift, or chute. General Electric Company, Schenectady, N. Y., announced an industrial storage-battery locomotive supplied with remote control to enable a distant operator to spot cars properly for dumping. Linn Manufacturing Company, Morris, N. Y., announced a new truck, Model C-5, that has the combination feature of operating either on flexible crawler tracks or on wheels.

COMPRESSORS — During 1939 the Sullivan Machinery Company introduced a new line of light-weight, portable air compressors called the Zeph-Air. These have two "V" vertical air-cooled cylinders, available in two sizes, with actual air delivery of 60 and 85 cu.ft. per minute. A new heavy-duty compressor providing 914 cu.ft. per minute, with a 150-hp. single unit and a twin arrangement of 1,828 cu.ft. per minute with a 300-hp. motor, was also announced. Late in December a new line of single-stage, single-acting compressors was announced, for use on surface or underground. Chicago Pneumatic Tool Company, New York, N. Y., brought out its new line of W-CO diesel-driven two-stage air compressors for heavy-duty operation. Ingersoll-Rand Company, New York, N. Y., announced its new line of two-stage, air-cooled portable compressors, in units from 85 to 315 c.f.m. of air at 100-lb. pressure.

PUMPS—To prevent corrosion, the Pomona Pump Company, Pomona, Calif., employs a molded plastic jet in its new jet pump introduced in 1939. Improved design of the diaphragm pump made by Hardinge Company, Inc., York, Pa., for handling underflow from thickeners, permits lengthening the stroke of the pump without stopping it.

CRUSHING AND GRINDING — A crusher containing two stages, the upper stage that crushes properly fed material and supplies a lower stage with adequate material all around its crushing bowl, was announced late in 1939 by the Traylor Engineering & Manufacturing Company, Allentown, Pa. The unit known as the Traylor-Sterns fine-reduction crusher is said to produce material between ⅛ and 9/16 in. according to the size of machine used. Allis-Chalmers Manufacturing Company, Milwaukee, Wis., announced its new Type "R" all-steel crusher working on the gyratory principle, said to operate at a higher speed than ever used before. Pioneer Engineering Works, Minneapolis, Minn., introduced its 2036 jaw crusher furnished with new-style jaw plates designed to eliminate slab-shaped rocks in the crusher product. Patterson Foundry & Machine Company, East Liverpool, Ohio, announced a tube mill for dry grinding of fine materials of both metallic and non-metallic type where agglomerates are likely to form. W. W. Gibson, Alameda, Calif., is reported to have patented a method which forces ball-mill liners securely against a rubber lining in their ball mills by means of cushioning the high-carbon manganese steel bars against rubber. For use in the laboratory, Braun Corporation, Los Angeles, Calif., announced an improved Type 6 sample grinder featuring a one-piece frame and trough alloy grinding plates.

BELTING AND CONVEYING—The practice of underground conveying of ore attracted further attention during the year, as another mine in the Iron Country, the Canisteo, of the Cleveland Cliffs Iron Company, plans installation of a conveyor system similar to the one underground at the Eveleth mine of the Oliver Iron Mining Company. Advancing its underground program of mechanization, the Consolidated Coppermines, Nevada, recently completed installation of an electric-driven Goodman shaking conveyor 150 ft. long to replace slushing operations on a certain level. The B. F. Goodrich Company, Akron, Ohio, announce a new cord conveyor belt. A feature of this belt is the composition of special anti-stretch cords, each entirely surrounded by rubber. Manufacturers brought out new and improved conveyor belt idlers to meet the demand for heavier duty. Robins Conveying Belt Company, New York, N. Y., announced a troughing idler permanently lubricated by the company's patented single-shot system and improved triple seals. The Pioneer Engineering Works, Minneapolis, Minn., announced a new conveyor idler claiming features of self-cleaning and simplified lubrication. Link-Belt Company, Chicago, Ill., announced its new Type 90 idler for conveyor widths of 14 to 24 in.

FEEDERS—Interest of mine operators in determining at any time the momentary load carried on the conveyor, and to make adjustments accordingly, prompted the Merrick Scale Manufacturing Company to supply two types of weightometers with built-in load indicator; also, where required, a 24-hr. chart recorder. A

EQUIPMENT

device called the Tellevel for starting and stopping conveyors feeding bulk materials to bins, and for opening and closing valves feeding into tanks, was announced by the Stephens-Adamson Manufacturing Company, Aurora, Ill. A new small model of dry-feeder machine, the FM-O-10, regulated by the amplitude of the feeding trough's electro-magnet vibrator, was brought out by the Syntron Company, Homer City, N. Y.

SEPARATORS—Designing a magnet for the specific application of directing a magnetic flux uniformly across the entire width of the magnet, the Dings Magnetic Separator Company, Milwaukee, Wis., announced its new rectangular-shaped suspension magnet in widths from 12 in. up to 60 in. Sterns Magnetic Manufacturing Company, Milwaukee, Wis., announced improvements of its Witherill Type R magnetic separator, that now incorporates a special feeding device. The company also announced a new vibro-magnetic analyzer designed to permit accurate and rapid determination of magnetic values in ore slurries.

CLASSIFIERS — Longer life for classifier rakes and tanks by the use of stainless steel with chromium is an important growing trend of interest to mill operators, according to the Rustless Iron & Steel Corporation, Baltimore, Md. For the separation of very fine classification problems, the Denver Equipment Company, Denver, Colo., announced its hydro-classifier of the spiral rake type. Hardinge Company, Inc., York, Pa., announced a new hydro-classifier in which the driving head embodies a geared motor head and the cast-iron housing upon which it is mounted. Western Machinery Company, Sacramento, Calif., announced an improvement in its bowl classifier that virtually eliminates surge. The Dorr Company brought out its Robot Lifting Device that automatically raises the rakes clear of the pulp pool in case of power failure. It also announced its Hyflow classifier for coarse separation in the 4- to 28-mesh range.

TABLES — Increased metallurgical efficiency and capacity are reported by the Deister Concentrator Company, Fort Wayne, Ind., by the use of its new Concenco anti-friction bearing head motion that is conducive to greater capacity for the Diester-Overstrom tables. The Sutton Steele & Steel air table of the Separations Corporation, New York, N. Y., has a new deck design that is said to handle larger tonnages.

SCREENS — Rapidly bouncing rubber balls between the secondary deck and cloth of the new Sta-Kleen screen of the Allis Chalmers Manufacturing Company feature the service offered by this new unit, said to prevent blinding of damp material passing over the screen. A so-called "liquid screen" designed by Robins Conveying Belt Company, New York, was brought out in 1939 for the purpose of clarifying a liquid, to dewater a solid or to combine these two operations. A small screen weighing 39 lb. and operating from any light socket for laboratory and foundry use was announced by the Universal Vibrating Screen Company, Racine, Wis. Productive Equipment Corporation, Chicago, Ill., announced the design and use of a special screen which serves as a grizzly screen and picking table. The Deister Concentrator Company, Fort Wayne, Ind., announced improved performance of its Model C-Leahy No-Blind vibrating screen by application of the company's new Tri-Vibe power panel.

FLOTATION EQUIPMENT — Improvement in design marked the chief advance made by manufacturers of flotation equipment. The Denver Equipment Company, Denver, Colo., modified the impeller of its "Sub-A" (Fahrenwald) flotation machine, with claims of reducing horsepower and greater aeration. Certain parts of the machine are now being made of molded rubber. The company also redesigned its "Sub-A" laboratory flotation cells. American Cyanamid Company, New York, N. Y., replaced the "clover-leaf" design on its S.S. type flotation machine by a recirculating compartment. All the company's Fagergren flotation machines are now powered by a high-speed standard vertical motor. In the field of research the company developed a new series of compounds known as the "600 Series" reagents, that counteract deleterious effects of carbonaceous gangue slimes in flotation. The Mine & Smelter Supply Company, Denver, Colo., announced that its automatic density controller has become firmly established in controlling single and two-stage grinding. Also that successful control is obtained by this device of the "heavy medium" in the sink-float process.

FILTERS — Interest in handling granular mineral products that may be sufficiently dewatered in an economical manner is said to offer an expanding field for the filter of top-feed design. Oliver United Filters, Inc., New York, announce their rotary vacuum filter, designed for top feed for this purpose. Oliver filters for gold-cyanide plants are now being constructed with flexible rubber hoses in the internal piping of the filter drum. International Combustion, Ltd., London, England, announced a new feature of its sectionalized Rovac filters, whereby all drainage is taken outside the drum.

EXCAVATORS—To move more material at less unit cost is one of the most common objectives of mine operators as well as manufacturers of large material handling equipment. During 1939 refinements of design and improvements in operation, together with use of alloy steels that can "take it," continue to be one of the most important contributions by manufacturers of material-handling equipment. R. G. Le Tourneau, Inc., Peoria, Ill., introduced its Model "S" Carryall scraper of 11-cu.yd. capacity. A larger pusher loader Carryall scraper, Model W of 23 cu.yd. capacity, designed to take advantage of two tractors in loading and one tractor in hauling and spreading, was also introduced by the company. To meet the need for an easily transported bulldozer the company introduced its knock-down bulldozer. Caterpillar Tractor Company, Peoria, Ill., introduced two new graders, No. 212 and 112, available with either diesel or gasoline power.

A combination shovel and dragline known as Type 1201 was announced by the Lima Locomotive Works, Inc., Lima, Ohio. It carries a 30-ft. boom, 20-ft. dipper handle, or a 3-cu.yd. bucket and is convertible for dragline or crane service. The Thew Shovel Company, Lorain, Ohio, introduced a new 1¾-cu.yd. excavator, the Lorain-80, that is available with interchangeable boom equipment as a shovel, dragline, crane, or clamshell. A new line of walking dragline excavators was announced by the Marion Steam Shovel Company, Marion, Ohio. Bucket sizes range from 3 to 12 cu.yd., with booms from 80 to 200 ft. Developments during the year by Sauerman Bros. Inc., Chicago, include new designs of two-wheel and four-wheel carriers for use in adapting the larger sizes of their Crescent scraper buckets for slack line operation. Their development of remote-control systems now permits four different systems of scraper or cableway hoist operations.

GOLD DREDGING EQUIPMENT—An important development in gold-dredge design, according to the Yuba Manufacturing Company, San Francisco, Calif., is the use of a.c. motors for bucketline drives using two motors connected by V-belts to the pulley shaft and through gear trains on each side of the upper tumbler. Jigs continue to be used on some gold dredges, and among manufacturers who announced new jigs during 1939 was the Mill & Mine Supply, Inc., Seattle, Wash., which brought out its twin diaphragm jig. Southwestern Engineering Company, Los Angeles, Calif., brought out its improved hydromotor jig for use on gold dredges and for mineral separation. Denver

(*Continued on page* 129)

Summary of the

MARKETS

NEW buying of consequence failed to materialize during January, and an easier undertone brought out lower quotations for copper, lead, zinc, tin, and silver. The *E. & M. J.* index of prices declined from 82.89 for December to 80.85 for January. The lull in activity was viewed in most quarters as a natural reaction from the period of hectic buying in the last quarter of 1939. Production of metals has increased and as the month ended there was talk of curtailing output of both copper and tin.

Copper Institute resumed publishing domestic statistics. Figures for the last five months of 1939 were lumped, but the totals revealed that stocks of refined copper declined from 316,543 tons at the end of July to 159,485 tons at the end of December. Though the statistics proved to be favorable, they exerted little or no influence on the market, largely because of some uncertainty in the export field. Large mine operators lowered the price to 12c., Valley, but some of the smaller producers and two custom smelters later offered copper at 11⅝c. As the month ended, the export and domestic quotations were exactly even, reduced to a refinery basis. Domestic sales for January amounted to 25,057 tons.

Japan and Russia took large tonnages late in 1939. During January, however, because of strained political relations, sellers here hardly knew what position to take in reference to accepting additional business from those countries. This uncertainty caused increased pressure on the domestic market.

Zinc was dull and the price was lowered one-quarter cent on Jan. 19. Imports of zinc in ore during December totaled 14,266 tons.

Lead, regarded as the best situated of the major non-ferrous metals, finally succumbed to the general price unsettlement, and the price declined one-quarter cent on Jan. 29.

Straits tin sold below 46c. on increased supplies. Silver was quiet. Quicksilver advanced sharply on what was described in the trade as pure manipulation by the Cartel.

UNITED STATES MARKET

1940	Electrolytic Copper		Straits Tin	Lead		Zinc
Jan.	Domestic (a) Refinery	Export (b) Refinery	New York	New York	St. Louis	St. Louis
2	12.275	12.375	48.750	5.50	5.35	5.75
3	12.275	12.375	48.000	5.50	5.35	5.75
4	12.275	12.400	47.500	5.50	5.35	5.75
5	12.275	12.375	47.500	5.50	5.35	5.75
6	12.275	12.375	47.500	5.50	5.35	5.75
8	12.275	12.400	47.750	5.50	5.35	5.75
9	12.275	12.375	48.125	5.50	5.35	5.75
10	12.275	12.275	48.000	5.50	5.35	5.75
11	12.275	12.275	47.500	5.50	5.35	5.75
12	12.100	12.300	47.125	5.50	5.35	5.75
13	12.275	12.400	47.250	5.50	5.35	5.75
15	12.025 @ 12.275	12.200	47.250	5.50	5.35	5.75
16	12.025 @ 12.275	12.225	47.000	5.50	5.35	5.75
17	12.025 @ 12.275	12.225	46.875	5.50	5.35	5.75
18	12.025	12.150	46.500	5.50	5.35	5.75
19	11.900	12.075	46.000	5.50	5.35	5.50
20	11.775	11.950	45.875	5.50	5.35	5.50
22	11.775	11.700	45.250	5.50	5.35	5.50
23	11.675	11.525	45.125	5.50	5.35	5.50
24	11.775	11.450	45.250	5.50	5.35	5.50
25	11.400 @ 11.775	11.450	45.375	5.50	5.35	5.50
26	11.400	11.450	45.625	5.50	5.35	5.50
27	11.400	11.450	45.750	5.50	5.35	5.50
29	11.400	11.400	46.000	5.25	5.10	5.50
30	11.400	11.400	45.875	5.25	5.10	5.50
31	11.400	11.400	45.625	5.25	5.10	5.50
			AVERAGES FOR MONTH			
	11.954	11.999	46.707	5.471	5.321	5.644
Jan.			AVERAGES FOR WEEK			
3	12.275	12.390	49.025	5.500	5.350	5.800
10	12.275	12.367	47.729	5.500	5.350	5.750
17	12.183	12.271	47.167	5.500	5.350	5.750
24	11.821	11.808	45.667	5.500	5.350	5.542
31	11.431	11.425	45.708	5.375	5.225	5.500
Jan.			CALENDAR WEEK AVERAGES			
6	12.275	12.380	47.850	5.500	5.350	5.750
13	12.246	12.338	47.625	5.500	5.350	5.750
20	12.025	12.138	46.583	5.500	5.350	5.667
27	11.602	11.504	45.396	5.500	5.350	5.500

SILVER, GOLD, AND STERLING EXCHANGE

1940	Sterling Exchange		Silver		Gold	
Jan.	"Checks"	"90-day" demand"	(c) New York	London	London	(d) United States
2	3.94000	3.88750	34.750	22.0000	168s	$35.00
3	3.93500	3.88125	34.750	21.6250	168s	35.00
4	3.92000	3.86625	34.750	21.3125	168s	35.00
5	3.91000	3.85500	34.750	21.5625	168s	35.00
6	3.92500	3.87250	(e)	(e)	(e)	35.00
8	3.92500	3.87500	34.750	21.8125	168s	35.00
9	3.95000	3.90000	34.750	21.8750	168s	35.00
10	3.94000	3.89500	34.750	22.0000	168s	35.00
11	3.94250	3.89750	34.750	22.2500	168s	35.00
12	3.94500	3.90000	34.750	22.3750	168s	35.00
13	3.96000	3.92000	(e)	(e)	(e)	35.00
15	3.96500	3.92250	34.750	21.7500	168s	35.00
16	3.96000	3.92000	34.750	22.1875	168s	35.00
17	3.94750	3.90500	34.750	22.6250	168s	35.00
18	3.95500	3.91375	34.750	22.2500	168s	35.00
19	3.96000	3.92125	34.750	22.0000	168s	35.00
20	3.95500	3.91500	(e)	(e)	(e)	35.00
22	3.95500	3.91500	34.750	22.0000	168s	35.00
23	3.96500	3.92625	34.750	22.0000	168s	35.00
24	3.97500	3.93750	34.750	22.0000	168s	35.00
25	3.97500	3.94000	34.750	21.8125	168s	35.00
26	3.97500	3.94000	34.750	21.9375	168s	35.00
27	3.98000	3.94000	(e)	(e)	(e)	35.00
29	3.98500	3.94250	34.750	21.8125	168s	35.00
30	3.99000	3.95000	34.750	21.0625	168s	35.00
31	3.98000	3.94000	34.750	21.3750	168s	35.00
			AVERAGES FOR MONTH			
	3.95442	.....	34.750	21.892	.....	35.00
Jan.			AVERAGES FOR WEEK			
3	3.94100	.....	34.750	.....	.....	.....
10	3.92833	.....	34.750	.....	.....	.....
17	3.95333	.....	34.750	.....	.....	.....
24	3.96083	.....	34.750	.....	.....	.....
31	3.98083	.....	34.750	.....	.....	.....

Calendar week averages; New York Silver; 6th, 34.750; 13th, 34.750; 20th, 34.750; 27th, 34.750.
(e) Not quoted (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash. New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound. the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotation deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout January.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1940 Jan.	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Seller
2	Not quoted			246.2500	246.0000	Not quoted							
3	"	"	"	246.5000	245.7500	"	"						
4	"	"	"	244.5000	243.5000	"	"						
5	"	"	"	245.2500	244.5000	"	"						
8	"	"	"	246.0000	245.0000	"	"						
9	"	"	"	250.0000	249.0000	"	"						
10	"	"	"	248.0000	246.7500	"	"						
11	"	"	"	246.5000	245.0000	"	"						
12	"	"	"	243.2500	242.7500	"	"						
15	"	"	"	242.7500	241.7500	"	"						
16	"	"	"	242.2500	242.0000	"	"						
17	"	"	"	241.7500	241.2500	"	"						
18	"	"	"	237.5000	238.0000	"	"						
19	"	"	"	234.5000	234.5000	"	"						
22	"	"	"	231.5000	231.7500	"	"						
23	"	"	"	232.0000	232.0000	"	"						
24	"	"	"	232.7500	232.7500	"	"						
25	"	"	"	234.2500	234.2500	"	"						
26	"	"	"	236.0000	236.0000	"	"						
29	"	"	"	238.5000	238.5000	"	"						
30	"	"	"	238.2500	238.2500	"	"						
31	"	"	"	237.5000	237.2500	"	"						
Average for month				240.716									

Prices for tin are the official prices of the London Metal Exchange, in long tons (2240 lb.). Trading in other metals remained suspended.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Feb. 1, 1940)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	20c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	80c.
Calcium, lb., ton lots 97 @ 98 per cent	Nominal
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carolads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$40.00
Quicksilver, flask of 76 lb., 100 flasks or more	$175.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	$28.00@$30.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent, Joplin, Mo., ton	$61.00@$67.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 49c.
50 @ 52 per cent	(b) 49c.
44 @ 48 per cent	(b) 46c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	$23.00
Domestic, 65 per cent and upward	(a)$21.00@$23.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$35.50

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$4.60
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$13.00@$15.00

ALLOYS

Berrylium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	11c.
Ferromanganese, 78 @ 82 per cent, gross ton	$100.00
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$2.00@$2.10

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$12@$16 50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.50
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.00@$7.00
Domestic, abrasive, 80 @ 84 per cent	$12.00@$14.00
Dalmatian, 50 @ 55 per cent	(a)$6.00@$7.00
French, 56 @ 59 per cent	(a)$7.00@$8.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$22.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in	30@35c.
2 x 2 in	50@60c.
3 x 3 in	$1.25@$1.35
3 x 4 in	$1.50@$1.60
3 x 5 in	$1.75@$2.00
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c.
Silica, in bags, 325 mesh, ton	$18.00@$40.00
Sulphur, Texas mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$23.50
Basic	$22.50
No. 2 Foundry	$23.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1939	1940	1939	1940	1939	1940
January	42.750	34.750	20.305	21.892	466.775	395.442
February	42.750	.....	20.370	.....	468.472	.....
March	42.750	.....	20.280	.....	468.370	.....
April	42.750	.....	20.031	.....	467.778	.....
May	42.750	.....	20.123	.....	467.988	.....
June	41.955	.....	19.505	.....	468.137	.....
July	34.944	.....	16.952	.....	468.031	.....
August	35.951	.....	17.719	.....	460.383	.....
September	36.956	.....	22.178	.....	398.820	.....
October	35.726	.....	22.736	.....	400.350	.....
November	34.750	.....	23.378	.....	391.457	.....
December	34.956	.....	23.263	.....	391.830	.....
Year	39.082	.....	20.570	.....	443.199	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		Electrolytic (a)	
	1939	1940	1939	1940	1939	1940	1939	1940
January	11.025	11.954	9.912	11.999	43.125	(b)	48.440	(b)
February	11.025	.....	9.735	.....	42.188	.....	47.375	.....
March	11.025	.....	9.888	.....	42.938	.....	48.120	.....
April	10.265	.....	9.820	.....	42.031	.....	47.833	.....
May	9.833	.....	9.738	.....	41.656	.....	47.528	.....
June	9.775	.....	9.738	.....	41.986	.....	47.528	.....
July	9.976	.....	9.944	.....	42.899	.....	48.863	.....
August	10.261	.....	10.211	.....	44.685	.....	50.409	.....
September	11.635	.....	11.685	.....	(b)	.....	(b)	.....
October	12.215	.....	12.491	.....	(b)	.....	(b)	.....
November	12.275	.....	12.929	.....	(b)	.....	(b)	.....
December	12.275	.....	12.631	.....	(b)	.....	(b)	.....
Year	10.965	.....	10.727	.....	c42.689	.....	c48.262	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotations. (b) No quotations. (c) Average for eight months.

LEAD

	New York		St. Louis		London			
	1939	1940	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.826	5.471	4.676	5.321	14.534	14.744	(a)	(a)
February	4.805	.....	4.655	.....	14.283	14.417	.....	.....
March	4.824	.....	4.674	.....	14.660	14.860	.....	.....
April	4.782	.....	4.632	.....	14.337	14.533	.....	.....
May	4.750	.....	4.600	.....	14.483	14.679	.....	.....
June	4.800	.....	4.650	.....	14.564	14.651	.....	.....
July	4.854	.....	4.704	.....	14.753	14.856	.....	.....
August	5.043	.....	4.893	.....	16.040	15.885	.....	.....
September	5.449	.....	5.299	.....	(a)	(a)	.....	.....
October	5.500	.....	5.350	.....	(a)	(a)	.....	.....
November	5.500	.....	5.350	.....	(a)	(a)	.....	.....
December	5.500	.....	5.350	.....	(a)	(a)	.....	.....
Year	5.053	.....	4.903	.....	b14.707	b14.828	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton. (a) No quotations. (b) Average for eight months.

TIN

	Straits, New York		Standard, Spot, London	
	1939	1940	1939	1940
January	46.404	46.707	215.435	240.716
February	45.640	.....	213.906	.....
March	46.213	.....	215.375	.....
April	47.160	.....	218.389	.....
May	49.031	.....	225.591	.....
June	48.853	.....	227.511	.....
July	48.548	.....	229.833	.....
August	48.793	.....	229.869	.....
September	64.588	.....	229.292	.....
October	55.580	.....	229.943	.....
November	52.322	.....	230.000	.....
December	50.740	.....	248.974	.....
Year	50.323	.....	226.177	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.500	5.644	13.682	13.887	(a)	(a)
February	4.500	.....	13.522	13.780	.....	.....
March	4.500	.....	13.728	13.961	.....	.....
April	4.500	.....	13.443	13.637	.....	.....
May	4.500	.....	13.717	13.938	.....	.....
June	4.500	.....	14.023	14.223	.....	.....
July	4.516	.....	14.235	14.435	.....	.....
August	4.719	.....	14.628	14.761	.....	.....
September	6.104	.....	(a)	(a)	.....	.....
October	6.500	.....	(a)	(a)	.....	.....
November	6.500	.....	(a)	(a)	.....	.....
December	5.980	.....	(a)	(a)	.....	.....
Year	5.110	.....	(b)13.872	(b)14.078	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pounds sterling per long ton. (a) No quotations. (b) Average for eight months.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1939 (a)	1940 (a)	1939	1940
January	58.400	79.038	20.000	20.000
February	55.000	.....	20.000	.....
March	54.259	.....	20.000	.....
April	50.000	.....	20.000	.....
May	50.000	.....	20.000	.....
June	50.000	.....	20.000	.....
July	50.000	.....	20.000	.....
August	53.704	.....	20.000	.....
September	64.200	.....	20.000	.....
October	74.600	.....	20.000	.....
November	75.000	.....	20.000	.....
December	75.000	.....	20.000	.....
Year	59.180	.....	20.000	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound: (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1939	1940	1939	1940	1939	1940
January	11.670	14.000	77.440	156.962	34.440	40.000
February	11.250	.....	85.227	.....	35.000	.....
March	11.269	.....	87.278	.....	35.000	.....
April	11.500	.....	90.800	.....	35.000	.....
May	11.712	.....	86.769	.....	35.000	.....
June	12.000	.....	86.615	.....	35.000	.....
July	12.000	.....	86.960	.....	35.000	.....
August	12.000	.....	84.407	.....	35.333	.....
September	12.910	.....	140.000	.....	40.080	.....
October	14.000	.....	145.600	.....	41.120	.....
November	14.000	.....	134.978	.....	40.000	.....
December	14.000	.....	141.200	.....	40.000	.....
Year	12.359	.....	103.940	.....	36.748	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk 13.415 for January. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum is dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1939	1940	1939	1940	1939	1940
January	21.50	23.50	20.50	22.50	21.00	23.00
February	21.50	.....	20.50	.....	21.00	.....
March	21.50	.....	20.50	.....	21.00	.....
April	21.50	.....	20.50	.....	21.00	.....
May	21.50	.....	20.50	.....	21.00	.....
June	21.50	.....	20.50	.....	21.00	.....
July	21.50	.....	20.50	.....	21.00	.....
August	21.50	.....	20.50	.....	21.00	.....
September	22.50	.....	21.50	.....	22.00	.....
October	23.50	.....	22.50	.....	23.00	.....
November	23.50	.....	22.50	.....	23.00	.....
December	23.50	.....	22.50	.....	23.00	.....
Year	22.083	.....	21.083	.....	21.583	.....

Iron, dollars per long ton. F. o. b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

Herbert P. Dickey is now with Macassa Mines, Ltd., at Kirkland Lake, Ont.

John Aho is now with Phelps Dodge at Bisbee, Ariz., as ventilation engineer.

T. B. Holmes, Keene, N. H., has gone to Campana, District of Capira, Panama.

O. W. Jarrell, of the department of geology, Harvard University, has gone to Guayaquil, Ecuador.

Donald S. Tedford, mining engineer, has gone from Piedmont, Mo., to Bauxite, Ark.

George A. Kervin is directing operations at the property of O'Okiep Copper at O'Okiep, Namaqualand, South Africa.

Ray A. Henderson has returned to San Jose, Calif., from the Philippine Islands, where has was employed in the mill of the San Mauricio mine, Camarines Norte.

Norman A. Carlile, formerly with Itogon Mining Company, Baguio, P. I., has returned to 226 W. Olney Ave., Philadelphia.

Thomas Bostict has been engaged as mill superintendent by Cia. Minera Las Animas, and has left Douglas, Ariz., for Campo Juarez, Caborca, Sonora, Mexico.

C. R. Hilton, manager of Mount Isa Mines, Ltd., is on a visit to the United States. During his absence **L. K. Jacobsen** is acting as manager.

C. R. Kuzell has succeeded **Michael Curley** (retired) as manager of the New Cornelia branch of Phelps Dodge Corporation at Ajo, Ariz.

Dr. Hans Pirow has resigned as a member of the board of Nundydroog Mines, Ltd., operating in the Kolar gold field of Mysore State, India.

Dr. Gilbert Wilson has been appointed to the staff of the department of geology of the British Imperial College of Science and Technology.

Russell B. Woakes has relinquished his position as general manager of Lake George Mines, Ltd. **H. K. Shirrefs,** mill superintendent, has also resigned.

C. N. Schuette, consulting mining engineer of San Francisco, recently left that city for a long business trip to Philadelphia and other Eastern cities.

James L. Leonard, of Spokane, Wash., past chairman of Columbia Section of the A.I.M.E., has been elected president of the Associated Engineers of Spokane, for 1940.

Ora E. Reaves, of Duluth, Minn., claims manager for M. A. Hanna Company, retired recently and was succeeded by **P. A. Carmichael,** safety engineer, of Iron River, Mich.

Charles H. Rutherford has been elected chairman of the Phoenix (Ariz.) Council of the Arizona Small Mine Operators Association.

M. L. Jacobs has been elected vice-president of the Bethlehem Steel Company, in charge of raw materials, succeeding **C. A. Buck,** who will continue

M. L. JACOBS

as vice-president and director. Mr. Jacobs joined Bethlehem Steel in 1916. Four years later he was advanced to the position of manager of quarries and in 1934 was made general manager of quarries. He is a graduate of Lehigh University, Class of 1910.

J. J. Beeson, consulting geologist and mining engineer, was on Jan. 9 indorsed by the Salt Lake City Chamber of Commerce for appointment as director of the Federal Bureau of Mines.

Col. H. W. Laws, of Victoria, B. C., has left the province for New Guinea, and from there will probably journey to England. He expects to be absent for some months.

Charles J. Short, recently and for some years chief engineer for Shattuck Denn Mining Corporation, has joined the staff of Cia. Minera de Oruro, at Oruro, Bolivia.

P. H. Reagan, of Patiño Mines & Enterprises Consolidated, Inc., has recently been appointed consulting mining engineer. He will make his offices in La Paz, Bolivia.

Urpo Kyto, president of the Champion City Mines, Inc., has been spending several weeks at the company's optioned Lucky Boy mine near Hawthorne, Nev., coming from his home in Duluth, Minn.

A. C. Eide, recently sales engineer for American Zinc Sales Company, has been made manager of the pigment division of the company, with headquarters at Columbus, Ohio.

C. J. Hutchinson, author of "The Jerk Line" in our January number, has been re-elected president of the West Coast Mineral Association, with headquarters at Seattle, Wash.

E. N. Pennebaker, geologist for the Consolidated Coppermines Corporation at Kimberly, Nev., left recently for Cuba, where he spent several months last year on professional work.

D. B. Pelton, formerly superintendent for Commonwealth Lead Mining Company, at Melrose, Mont., is in charge of the Gold Note mine at Kennedy, Nev., for a group of Utah operators.

J. R. Hobbins, executive vice-president of Anaconda Copper, arrived in Butte on Jan. 22 on company business. While in Montana he will also visit Anaconda and Great Falls.

R. Beresford Ash, underground manager of Great Boulder Proprietary Gold Mines, Ltd., Kalgoorlie, W. A., returned to Australia during November last, from an overseas visit.

G. B. Blonsky, formerly superintendent of Operator Consolidated Mines Company, Randsburg, Calif., has joined the staff of Custer Consolidated Mines, Inc., Sunbeam, Idaho.

J. B. Gowan, Jr., geologist for the Anaconda Copper Mining Company at its zinc properties in Poland, has returned to Butte and is now attached to the geological staff of that company in Butte.

J. A. McDonald, until recently chief field engineer for the St. Joseph Lead Company at Sheepranch, Calif., is now in charge of mining operations of Westvaco Chlorine Products Corporation, Livermore, Calif.

Wilfred R. Baseden, business manager of the Chile Exploration Company at Chuquicamata, Chile, recently visited Vancouver, B. C. Unable to make a contemplated trip to Europe, he is making a leisurely tour over America.

Ralph N. Hoffman, formerly mechanical superintendent for the Andes Copper Mining Company at Potrerillos, Chile, has arrived at Morenci to direct the construction of the new 25,000-ton concentrator of the Phelps Dodge Corporation.

C. M. Campbell, mining engineer, has temporarily joined the staff of the Mining Association of British Columbia. His duties will be to compile statistics on mine accidents in connection with the Association's accident prevention campaign.

J. B. Haffner, of the staff of the Consolidated Coppermines Corporation, of Kimberly, Nev., has been elected a member of the 100,000 Mile Club of United Airlines. The club is an exclusive organization of persons who have flown 100,000 miles on commercial airliners.

B. M. Snyder, consulting mining engineer of 117 South Sycamore St., Los Angeles, has completed an examination of the Gold King mine in the Hualapai Mountains of Arizona, and is now examining the well-known Morning Star channel placer mine at Iowa Hill.

Edmund M. Wise, staff advisor of the research laboratories of the International Nickel Company, Inc., at Bayonne, N. J.,

has been elected chairman of the Institute of Metals Division of the A.I.M.E. for 1940.

R. L. Shimmin is now mill superintendent for the Rico Argentine Mining Company at Rico, Colo. Until recently Mr. Shimmin was mill superintendent at the Ash Peak Branch of Veta Mines, Inc., at Hardy, Ariz. The Ash Peak Branch closed down completely on Dec. 1, 1939.

Martin Hannifan, of Fallon, Nev., honor 1939 engineer graduate of the University of Nevada, sailed lately from New York for Chile to take employment with the Andes Copper company. He had been employed at the Walker copper mine in Plumas County, Calif.

Dr. Ian W. Wark has joined the staff of the Council for Scientific and Industrial Research, Melbourne, Australia. For the past ten years he has been engaged on fundamental flotation research work at the University of Melbourne.

Army Adams, of Grass Valley, Calif., who has been running a hydraulic operation at Poverty Hill mine, on an ancient channel near La Porte for San Francisco capital, was forced to close down on Jan. 5 due to extreme weather conditions.

D. J. Parker, who for eleven years has been acting as district engineer at Butte, Mont., for the United States Bureau of Mines, safety division, with headquarters in Salt Lake City, has gone to College Park, Md., to act as assistant to Daniel Harrington, chief of the division of health and safety at that station.

A. S. Walter, dean of mining and metallurgy, New Mexico School of Mines, was elected president of the New Mexico Miners and Prospectors' Association at its annual convention held in Albuquerque Jan. 19 and 20. **C. S. Elayer,** Vanadium, N. M., is vice-president, and **R. U. Twiss**, also of Vanadium, is secretary-treasurer.

Henry C. Carlisle, consulting engineer of San Francisco, recently made an examination of the operations of the Mammoth-St. Anthony, Ltd., 45 miles northeast of Tucson, Ariz. He has temporarily been appointed general manager of the company to fill the position of the late Foster S. Naething. Mr. Carlisle will give only part of his time to the operations of Mammoth-St. Anthony, Ltd., while still having headquarters in San Francisco.

Gustav N. Helling has recently completed construction of a Straub 60-ton ball mill and kraut flotation unit for the Compania Minera y Exploradora de Costa Rica. The mines are at Abangarez and are leased from the Keith Abangarez estate. Prior to designing the Alajuelita Abangarez mill he was superintendent of the Jabali Chontales mines in Nicaragua, at Agua Fria, Honduras. He was superintending the Piedra Blanca units of that company.

Kenneth C. Vincent, who had been recently employed by the research department of the American Smelting & Refining Company in Utah, is at the Massachusetts Institute of Technology, where he is studying under **Professor Antoine M. Gaudin,** who was recently appointed Richards professor of mineral dressing at M.I.T. Mr. Vincent will specialize in the study of the effects of alkali xanthate in flotation practice. He is the first holder of the Dow fellowship, the research being conducted under an award made by the Dow Chemical Company.

Dr. John B. Hanley, of Lewiston, Me., has been appointed assistant state geologist of Arkansas. He is the first assistant geologist ever appointed by the Arkansas geological survey. Dr. Hanley is a graduate of Bates College in Maine and has graduate degrees at two other Eastern colleges. Until recently he was geology instructor at Dartmouth university.

W. L. Taylor, of Hibbing, Minn., was recently elected president of the Engineers' Club of Northern Minnesota for 1940. **Glen B. Lerch** was elected vice-president and **H. M. Pickering** secretary-treasurer. Directors are: **Bert St. Vincent,** Hibbing district; **Edwin A. Sweetman,** Virginia; **O. A. Sundness,** Chisholm; **H. T. Reifel**, Eveleth; **R. W. Whitney,** Nashwauk; **E. Frank Fochtman,** Bovey; **Lyle Hendricks,** Hibbing; and **E. Johnson** (alternate director), Virginia, Minn.

M. E. Pratt, who has been acting as general superintendent of the Octave mine, at Octave, Ariz., for the American Smelting & Refining Company, has returned to Ecuador to direct the mining development of Zamora Mines Corporation concession which Mr. Pratt recently obtained for the company. His address in Ecuador will be Zamora Mines Corporation, Loja, Ecuador. In his absence from the United States **LaMont West** has resumed as manager of Octave mine, a post he held during Mr. Pratt's previous professional work in Ecuador.

William B. Daly, manager of mines in Montana for the Anaconda Copper Mining Company, recently announced his retirement from active service with the company, continuing, however, in a consulting capacity. He has been succeeded by **James J. Carrigan,** formerly general superintendent of mines. Other personnel changes: **Edward S. McGlone** becomes general mine superintendent; **Eugene Hogan** has been made assistant general superintendent of mines; and **Joseph P. Ryan,** formerly chief assistant foreman at the Belmont property, becomes mine foreman of the Emma mine.

▼ ▼ ▼

OBITUARY

S. Frank Hunt, discoverer of the Rio Tinto copper mine, in Nevada, died at La Jolla, Calif., on Jan. 6, aged 76.

Henry G. Dalton, of Cleveland, Ohio, senior partner of Pickands, Mather & Company, died in Cleveland Dec. 27.

D. B. Mikesell, president and founder of the American Brattice Cloth Corporation, of Warsaw, Ind., died on Jan. 19.

John H. Nordquist, district mining engineer in the Coeur d'Alenes, prominent in Idaho politics, died at Wallace, Idaho, Jan. 16, at the age of 72.

George W. Starr, a mining engineer long identified with Western mining enterprises, died on Jan. 21, in San Francisco, at the age of 77.

Cullen Van Rensselaer Cogswell, of New York, long interested in various mining enterprises in Mexico, died on Jan. 20 at the age of 69.

Alex Gillies, who, with Benny Hollinger is credited with the discovery, 30 years ago, of the Hollinger gold mine, in the Porcupine area of Ontario, died at Toronto on Jan. 19 at the age of 62.

Lewis J. Brown, president of the International-Stacey Corporation, and chairman of the board of the Roots-Connersville Blower Corporation, died at Columbus, Ohio, on Jan. 11.

Lewis N. Merritt died recently at Pasadena, Calif. He was a former Minnesota resident and the son of Lewis J. Merritt, one of the famed seven Merritt brothers who discovered the Mesabi iron range, in Minnesota.

Arlington P. Little, professor of electrical engineering at the Colorado School of Mines and a member of the faculty of that institution for more than twenty years, died at Golden, Colo., on Dec. 28 last at the age of 60.

Alfred Page, a pioneer mining man in the Coeur d'Alenes of Idaho, died at Spokane, Wash., Jan. 12. He owned at one time the Page mine and had other mining interests in Idaho. He was prominent in political affairs and at one time was state senator. He was 87 years old.

Charles Hussey, secretary and manager of Standard Silver-Lead Mining Company, died in Spokane, Wash., Jan. 18. He was born at Des Moines, Iowa, and went to the Coeur d'Alenes and finally to Spokane 40 years ago. He and his father opened the First National Bank in Spokane, in 1901. He was 79 years of age.

R. B. Brown died at his home in Merced, Calif., on Jan. 4. Born in York County, Neb., on June 23, 1881, he began his mining career at the Homestake mine, in South Dakota. He later moved to Butte, Mont., and during his life held responsible positions in Butte, Montana, Kimberly, and Ely, Nev. He was underground manager for the Rhokana Corporation in Northern Rhodesia from 1929 to 1933.

J. O. A. Carper, a nationally known mining engineer, died at Denver, Colo., the day before Christmas, at the Porter sanitarium. He was 74 years of age and been active in mining for a half century. At the time of death he was consulting engineer for the Arizona-California Exploration Company, operating the Pope mine 20 miles northeast of Chloride. He was also manager of the Squaw Gulch mine at Cripple Creek. He was a member of the Institute of Mining and Metallurgical Engineers, the American Mining Congress and the Colorado Mining Institute. He originated the "Sowbelly" dinner of the Colorado Miners Association, an annual festive occasion in Colorado mining circles.

What Metal Statistics Show

PRODUCTION in mining districts so far during the winter has held at a good rate. Cold weather in some areas has forced temporary suspension of milling operations, especially in the Tri-State region and in some Western districts. The let-up in demand for copper, lead, and zinc, with the resultant lowering of their prices, is viewed by the industry as a natural movement following the high rate of activity in 1939. Curtailment in copper output has virtually started at some mines, as producers desire to prevent an unwieldy supply situation in the face of the continued cautious attitude of consumers. Lead output is expected to continue at a satisfactory rate, but the influx of foreign zinc entering under the tariff has closed a number of zinc mines and reduced employment in that industry.

The figures released by the Copper Institute were lumped from August to December. Though refined stocks show 159,485 tons, the industry believes the high rate of mine output during the last quarter has increased total stocks in view of the dull market since Jan. 1.

It is reported that copper from Africa may be sent here in larger volume for refining purposes and reshipped to Europe as refined metal or in fabricated products.

Duty-free domestic copper statistics in short tons (Copper Institute) follow:

	—Production— (a) Crude	Refined	(b) Stocks Refined
Year 1935	.....	.....	231,415
" 1936	731,629	748,660	161,068
" 1937	982,045	964,176	259,351
" 1938	644,869	638,076	289,755
" 1939	836,371	818,289	159,485
Jan.....1939	69,170	66,316	301,244
Feb. "	60,707	59,452	309,119
March "	61,752	66,718	320,812
April "	62,548	58,368	332,513
May "	58,600	68,536	337,155
June "	59,672	61,719	335,012
July "	54,850	57,339	316,543
Aug.-Dec. "	409,072	379,841	159,485

	—Deliveries to Customers— Domestic	Export	Totals
Year 1936	764,560	54,447	819,007
" 1937	803,095	62,798	865,893
" 1938	481,803	125,869	607,672
" 1939	814,407	134,152	948,559
Jan.....1939	51,059	3,768	54,827
Feb. "	48,267	3,310	51,577
March "	50,803	4,222	55,025
April "	42,404	4,183	46,667
May "	51,225	12,669	63,894
June "	53,573	10,289	63,862
July "	59,681	16,127	75,808
Aug.-Dec. "	457,315	79,584	536,899

(a) Smelter production and custom intake, including scrap. (b) At refineries, on consignment, and in Exchange warehouses, but not including consumers' stocks at their plants or warehouses.

Exports of refined copper from the United States—foreign and domestic metal—during November and December, in short tons, follow:

To:	Nov.	Dec.
Belgium	.....	672
Denmark	281	108
France	6,000	19,846
Germany	.....	.....
Great Britain	28	849
Italy	1,907	1,510
Netherlands	689	224
Sweden	2,632	2,407
China and Hongkong	.....	687
Japan	14,124	16,839
Other countries	(a)8,058	21,879
Totals	33,739	56,012

(a) Includes 5,691 tons exported to Russia.

Exports of refined copper in 1939 totaled 372,665 tons, against 370,545 tons in 1938. Most of the copper exported is metal refined in this country in bond. In 1939 Russia imported 22,748 tons of refined copper (domestic and foreign metal) from the United States, against 55 tons in 1938. All of the 1939 tonnage was shipped in November and December, 5,691 and 17,057 tons respectively.

▶ QUICKSILVER—A summary of the United States Bureau of Mines' latest report on the position of quicksilver in this country follows, all figures in flasks of 76 pounds:

Consumption	2,800	2,400
Production, domestic	2,500	1,600
Imports	200	1,111
Exports	364	223
Consumers' stocks (a)	8,500	8,700
Stocks in dealers' and importers' hands	2,400	2,400
Stocks held by producers (b)	178	331
Total stocks	11,078	11,431

(a) Stocks at consumer's plants, in bonded warehouses and owned by consumers, and in transit except metal afloat from abroad. (b) Stocks held by companies reporting to the Bureau (34 mines).

▶ TIN—World tin stocks, including tin in ore and in process at smelter, amounted to 50,407 tons at the end of December, against 50,607 tons a month previous and 49,448 tons a year ago, according to the International Tin Research and Development Council.

The Army and Navy Munitions Board has issued a warning directed against the exportation of strategic materials that might weaken the national defense position of the United States. The reexports of tin and rubber have increased, principally to Russia and Germany, in the face of a warning issued by the Government on Oct. 11, 1939.

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922-3-4)

1929	110.33	1934	69.56
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67

1939..... 77.71

	1938	1939	1940
January	75.56	77.12	80.85
February	73.43	76.89	....
March	72.41	77.09	....
April	71.19	74.79	....
May	69.15	73.61	....
June	67.55	73.17	....
July	72.95	71.95	....
August	73.94	73.88	....
September	74.70	83.07	....
October	77.61	84.25	....
November	78.36	83.80	....
December	77.13	82.89	....

▶ LEAD—Domestic shipments of lead to consumers during December fell a little short of expectations, with the result that stocks at the end of the year stood at 58,777 tons, or 716 tons higher than a month previous. Production from domestic ore was moderately lower than in November.

The record for the years 1938 and 1939, in short tons, follows:

	1938	1939
Stock at beginning	129,131	115,902
Production:		
Domestic ore	381,849	462,213
Secondary and foreign	26,690	35,778
Totals	408,539	497,991
Domestic shipments	421,625	555,074
Stock at end	115,902	58,777

The November and December figures for refined lead compare as follows:

	Nov.	Dec.
Stock at beginning	73,963	58,061
Production:		
Domestic ore	44,748	42,547
Secondary and foreign	3,719	3,068
Totals	48,467	45,615
Domestic shipments	64,365	44,881
Stock at end	58,061	58,777

Industrial classification of domestic lead shipments for the years 1938 and 1939, in short tons, according to the American Bureau of Metal Statistics:

	1938	1939
Cable	51,571	64,599
Ammunition	17,832	27,107
Foil	21,981	21,768
Batteries	43,202	77,746
Brass-making	2,365	4,078
Sundries	31,624	41,298
Jobbers	7,027	8,291
Unclassified (a)	246,023	310,187
Totals	421,625	555,074

(a) Pigments, oxides, solder, babbitt, pipe and sheet, lead for tempering gasoline, and some going into ammunition not credited under that classification.

▶ ZINC—The November, December, and January statistics of the American Zinc Institute, covering all grades, are summarized as follows in tons:

	Nov.	Dec.	Jan.
Stock at beginning	72,495	61,522	65,995
Production	53,524	57,941	57,158
Production daily rate	1,784	1,869	1,844
Shipments	64,407	53,468	57,551
Unfilled orders	66,197	53,751	36,808
Stock at end	61,522	65,995	65,602

Figures covering operations of the Prime Western division, for November, December and January, follow:

	Nov.	Dec.	Jan.
Stock at beginning	36,021	30,941	30,052
Production	23,626	25,497	24,689
Shipments	28,706	26,386	27,929
Stock at end	30,941	30,052	26,812

Old tailings at the Mountain Copper Company near Redding, Calif., are hauled by track type wagons to the cyanide plant for treatment

CALIFORNIA

Lakeview District to Have a Custom Mill

Activity in this area points toward revival of gold mining—Pouring of concrete under way at Upper Narrows debris dam—More dredging operations being planned in Siskiyou, Nevada, and Placer Counties

▶ A revival of gold mining is under way in the Lakeview district of Modoc County. William Broadus, operator of the Klondyke property, is erecting a 200-ton custom mill to handle Klondyke ore and production from nearby mines, including the Blue Bell, developed by William Larkin. The Big Four mine holdings worked under lease by Modrell brothers, of Lakeview, are to be equipped with a large milling plant in the spring, and a 15-ton mill has recently been completed at the Consolidated property. Near Alturas, M. Williams and associates have leased the Pleasant quicksilver mine, and development work is to be undertaken at once.

▶ Concrete work has been started at the Upper Narrows débris in course of construction on the Yuba River near Smartville, Yuba County. This dam is the second of four to be erected on the American, Bear, and Yuba rivers to make possible large-scale hydraulic mining operations in central California gravel areas. The work is directed by United States Army engineers, and the cost of the structure is estimated at $4,000,000.

▶ The Coan mine, near Nevada City, is being rehabilitated by Thomas Coan and his associate, John West, of Los Angeles, following a long shutdown brought about by a destructive fire several years ago. Surface construction work includes erection of a 45-ft. headframe, compressor and hoist houses, and reconditioning of the ten-stamp mill. The mine is opened by a 500-ft. shaft.

▶ Bear State Gold Mines is reported to have completed preparations for extensive operation of its Bear State and Red Rock hydraulic properties near Volcanoville, El Dorado County. Two hydraulic giants are to be operated, with tailings to be temporarily stored behind a small dam erected by the company, pending completion of the Ruck-A-Chucky débris dam. J. P. Donovan, is superintendent.

▶ The Rainbow mine, near Pine Grove, Amador County, has been reopened by Rainbow Mines, Inc., and rehabilitation of the shaft and sinking of a new one 200 ft. from the old workings is in progress under the direction of C. L. Cameron, vice-president and general manager. Installation of a power plant and mill is planned.

▶ Following extensive test work, Yreka Gold Dredging Company, Etheridge Walker, president, is reported to have acquired a large area of dredging ground in the Seiad Valley district of Siskiyou County, including the Ariel Lowden ranch, Grant Lowden holdings, and the Hubbard and Hawkes properties, and early erection of a large bucket-type dredge is planned. The company operates a 6-cu.ft. dredge near the city of Yreka, with E. Peterson, dredge master, in charge.

▶ Dredging operations have been started by Greenhorn Dredging Company on a large gravel tract on Greenhorn Creek, in Nevada County, where a 1½-cu.yd. dragline dredge unit was completed recently. Ten men are employed on the project.

▶ The dragline dredge of Innis Dredging Company has been moved from Deer Creek, Nevada County, to the Oest and Hubbard holdings on Dry Creek about 6 miles northwest of Auburn, Placer County.

▶ Plans are maturing for the construction of a 150-ton mill at the Dutch property near Jamestown, Tuolumne County, operated by Allied Mines, Inc., where a 60-ton flotation plant is in operation. The company also controls the neighboring Heslop, Sweeney, and App mines, as well as the Plumbago mine, in Sierra County, and the American Girl property in Imperial County. Sufficient ore reserves have recently been developed to warrant installation of a larger milling unit. About 23 men are employed, and R. K. Brown is superintendent.

▶ In the Grass Valley area of Nevada County shaft sinking operations are proceeding at the Boundary mine operated by John Becker, a new steel headframe is being erected at the Pennsylvania shaft of Empire Star Mines Company, Ltd., and active development work is in progress at the company's Dannebroge mine a short distance from the Pennsylvania. Operations at the Pennsylvania and Dannebroge properties are directed by Robert J. Hendricks, manager.

ARIZONA

Some Silver Mines Being Rehabilitated

Properties in Mohave and Gila Counties are expected to start production soon—Mill operations increased at Boriana tungsten mine to a two-shift basis

▶ The Symon Brothers Screen Company have closed a contract with the Watt Thompson Estate, owner of the Silver King mine, and with J. H. Cochran, owner of the Gold Medal group of claims about 20 miles southeast of Kingman in Mohave County. Work is to begin immediately on both properties. Road work is the first requirement at the Gold Medal group, and Brice Covington of Kingman has the contract for road construction.

▶ A shaft is being sunk on the Bracco group of claims seven miles north of Globe. The vein is thought to be an extension of the Centennial vein, which produced much high-grade silver ore in the past. The mine is owned by John and James Bracco of Globe, Arizona.

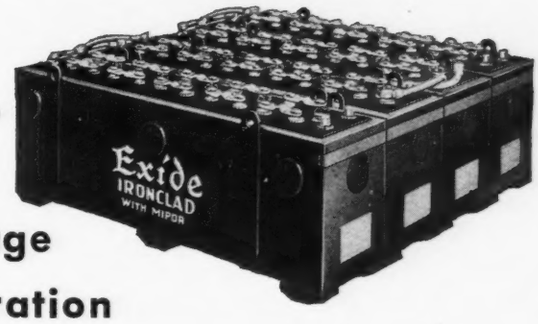
▶ The Boriana tungsten mine, 20 miles east of Yucca, operated by the Molybdenum Corporation of America, has increased mill operations to a two-shift basis. Mine and mill operations are under direction of H. L. Veatch, Yucca postoffice.

▶ The Goodman mine, owned by Mrs. Angela Scott, of Quartzsite, has been leased to Dr. C. H. Stone of Blythe, Calif. Eight men are employed constructing a pilot mill. Multiple rolls are to be used in crushing. John H. Marks, of 1026 Seventeenth St., Denver, Col., is engineer of the project.

▶ Charles Brightwell, of Brooklyn, N. Y., and Hardy A. Norville, of Phoenix, are planning the development of the Bronx molybdenum mine nine miles west of Miami. They plan the erection of a 50-ton plant.

▶ Surveys and preliminary work for a 150-ton mill at the Groom mine of the California-Engels Mining Company, near Wickenburg, are under way, under the direction of Roger L. Beals, mining engineer, according to the officers of the company. Recently a new vein of gold ore, 5 ft. wide, was cut on the 100-ft. level of the New Groom shaft, between the E. East vein and the East vein. This will add to the estimated

From copper to salt...



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▶ARIZONA

two years' supply of ore, averaging $7.78 a ton, now declared to be available for a mill. Since November, 1938, when the company took over the property, it has been engaged in development work that has disclosed the present tonnage. Recently the California-Engels Mining Company completed its registration with the SEC for the financing of the erection of the mill.

▶ The Lime Cap group of claims north of Metcalf is mining and shipping lead-zinc ore to the Ozark Smelting & Mining Company at Coffeyville, Kan. Considerable development work is planned. The mine is owned by Danenhauer brothers and S. G. Murillo, of Clifton, and is under lease to D. B. Leake, also of Clifton.

▶ E. D. Morton, general manager of the Montana Mines Corporation at Ruby, has taken a 90-day lease on the former Griffith-Jenkins group. Four carloads of low-grade manganiferous gold-silver ore were shipped to the Hayden and Superior smelters, but the ore was found to be not adapted to the processes used there. Additional work is planned to develop sulphide ore. The group joins the old Montana mine.

▶ L. E. Wemple, of 47th and Sacramento Sts., Chicago, and associates have taken over a fluorspar property near Duncan, and plan the early construction of a milling plant. Mr. Wemple was formerly president of the Peru Mining Company, of Deming and Hanover, N. M.

▶ Jacob Judesh, of Globe, reports that his Rescue mine, six miles northeast of that city, has been sold to California interests and operations are expected to commence soon. The agreement also includes the Rambo and Silver Glance claims which adjoin the Rescue.

▶ The Oro Grande mine, five miles north of Wickenburg, has been reconditioned and put in operation. One shift is working in the mine and three shifts are engaged at the 50-ton mill. The mine is under lease to William Gosnell and Howard Sanborn, of Rochester, Minn. Donald Finlayson is superintendent.

▶ R. C. Huffman Construction Company of 610 Brisbane building, Buffalo, N. Y., has a crew making an examination of the Chimehuevis placers, 20 miles south of Franconia, in Mohave County. They recently completed an examination of the Mackey placers near Quijotoa, Ariz. R. B. Hoffman, mining engineer, and A. F. Eberwine, vice-president of the company, are in charge of the exploratory work.

▶ Work has been resumed on the North Star mine in the Kofa district north of Yuma. The old tailings dump will be treated with cyanide. Andy Rogers is in charge.

▶ Winslow Gold Mining Company, operating the Yarnell mine, at Yarnell Hill, has its 100-ton cyanide plant operating on a three-shift basis. Mark Gemmill, general manager, is in charge of extensive development work in the mine, where work is carried on a two-shift basis. The company has 25 men on the payroll. Hugh Hubbard is superintendent at the mine and James Champie at the mill.

NEVADA

Consolidated Coppermines Decides Not to Build Mill

Agreement on a new contract with Kennecott Copper Corporation to continue treating their ore on a higher tonnage basis cancels construction of their 8,000-ton plant —Cyanide mill at Dan Tucker mine completed

▶ A new contract was signed (as of Feb. 1) on February 6 between officers of the Kennecott Copper Corporation and the Consolidated Coppermines Corporation in connection with future treatment of the latter company's ore, following early expiration of the contract under which the former's subsidiary, Nevada Consolidated Copper Company, has been treating 6,000 tons of Coppermines ore per day in its concentrator and smelter at McGill. Terms of the agreement include shipment of 9,000 tons of ore per day to the McGill plant and under certain conditions this may be increased. Beginning Oct. 1940, transportation cost will be reduced 1 cent per ton and milling charges dropped 7 cents per ton, a total of 8 cents per ton from these two items.

▶ A 70-ton all-sliming cyanide mill has been completed on the Dan Tucker gold-silver mine, 30 miles east of Fallon, in Churchill County, by the Summit King Mines, Ltd., wholly-owned subsidiary of Bralorne Mines, Ltd., of British Columbia, with main offices in Vancouver. Percy G. Dobson is manager, with office at Fallon, Nev.

▶ In the Federal court at Carson City, Judge F. H. Norcross has granted the petition of the Nevada Custom Milling Company for permission to retain possession of its leased 150-ton flotation mill at the Lucky Boy silver-lead mine, near Hawthorne, in Mineral County, under the amended Federal bankruptcy act. In late months the mill has been reconditioned and some custom ore has been treated. J. M. Hoff is manager, with office at Hawthorne.

▶ A syndicate that includes the Natomas company and a group of San Francisco business men has taken over the placer property of the Greenan Placers, Inc., embracing 6,000 acres below the outlet of Copper Canyon, 16 miles southwest of Battle Mountain in Lander County, and extensive test work, with several churn drills, is in progress to recheck the results obtained in similar work. President James O. Greenan said that drilling on 250-ft. centers had proved approximately 27,000,000 cu.yd. of gravel averaging 25c. per yard, and drilling on 1,000-ft. centers had indicated an additional 44,000,000 cu.yd. averaging 16c. Depth of pay gravel ranges from 60 to over 200 ft. Richard Smith is superintendent, and Col. W. H. Lanagan, of Battle Mountain, is consulting engineer for the Natomas company.

▶ Goldfield properties of the Goldfield Consolidated Mines Company have again been opened to lessees and a number of applications have been received by W. F. McNair, local manager, and forwarded to the Reno office for approval. The accessible mines are the Mohawk, Clermont, Grizzly Bear, Red Top, and Laguna. Few leases have been granted since the mines were optioned several years ago to the Eastern Exploration Company, subsidiary of the Calumet & Hecla Consolidated Copper Company, but earlier leases were a notable factor in the nearly $90,000,000 output of the mines.

▶ The 1,200-ft. four-compartment Locan shaft of the Richmond Eureka Mining Company on Ruby Hill, two miles west of Eureka, Nev., is being reopened, a new headframe, compressor, and hoist equipment having been provided by the Eureka Corporation, Ltd., a Canadian group with offices at Toronto, holding the large lead-silver properties under lease and option from the United States Smelting, Refining & Mining Company. William Sharp is in charge at Eureka.

▶ Officers of the Prince Consolidated Mining Company at Pioche, Lincoln County, have announced the purpose to unwater the 825-ft. main shaft and to conduct development work at greater depth, ore beds having been proved some years ago by diamond drilling between depths of 800 and 1,075 ft. David B. Gemmell, Jr., is president and manager.

▶ Dividend No. 14 was paid on Jan. 26 by the Getchell Mine, Inc., at the rate of 3c. per share, amounting to $45,000 and bringing total disbursements to $765,000 within a period of seventeen months. Installation of a 260x7½-ft. rotary furnace was completed late in December. With further minor adjustments, capacity of the cyanide mill will soon exceed 1,000 tons per day.

▶ A large deposit of iron sulphides has been struck on the 1,735-ft. level of the Bristol Silver Mine, Jack Rabbit district, Pioche, reports J. H. Buehler, superintendent. The ore is associated with the first limestone in the Prince series.

▶ The capacity of the Rip Van Winkle Mining Company's mill near Elko, Nev., has been increased to 85 tons daily. The shaft is being sunk 200 ft. deeper. L. S. Breckon, of Copperton, Utah, president, reports that 50,000 tons of ore have been developed.

New Mexico

▶ The Exploration Syndicate, Inc., has been organized in Salt Lake City with Alfred Frank as president and treasurer, Continental Bank Building, to operate the East Camp mine, Steeple Rock district, Grant County, N. M. A mill of 75-ton daily capacity is being constructed. About 25,000 tons of ore averaging 25 oz. of silver and 0.37 oz. gold to the ton has been shipped during the last three years of the mine's operations by Sale Lake investors. S. F. Ballif, Jr., of Los Angeles, is vice-president, and Miriam Hoff, Salt Lake City, is secretary.

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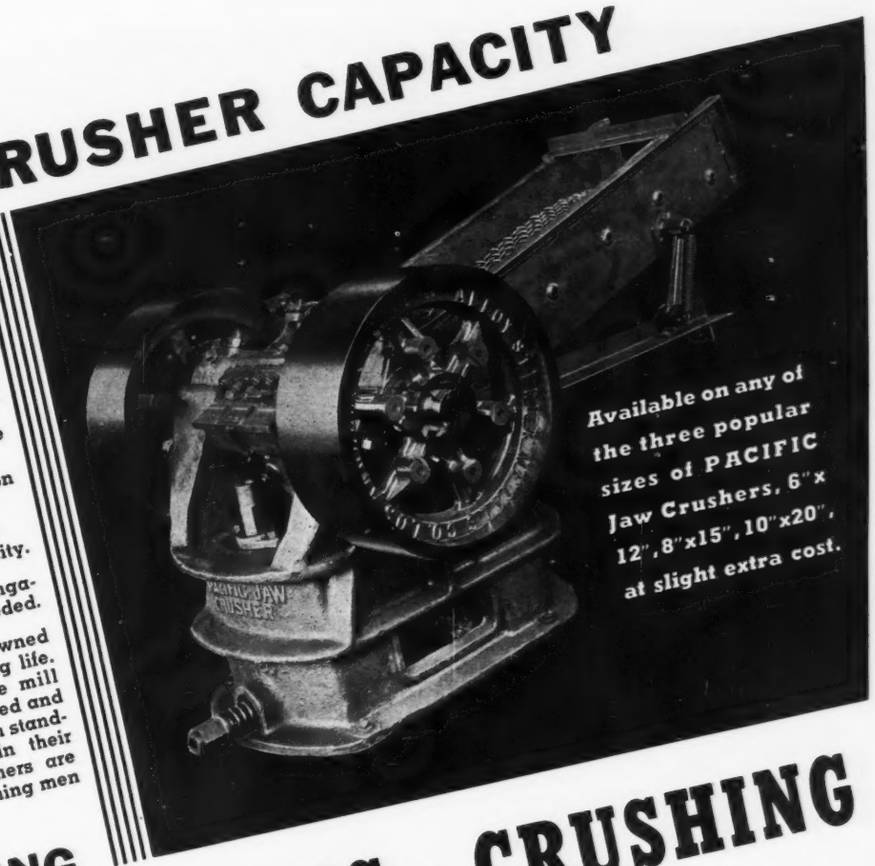

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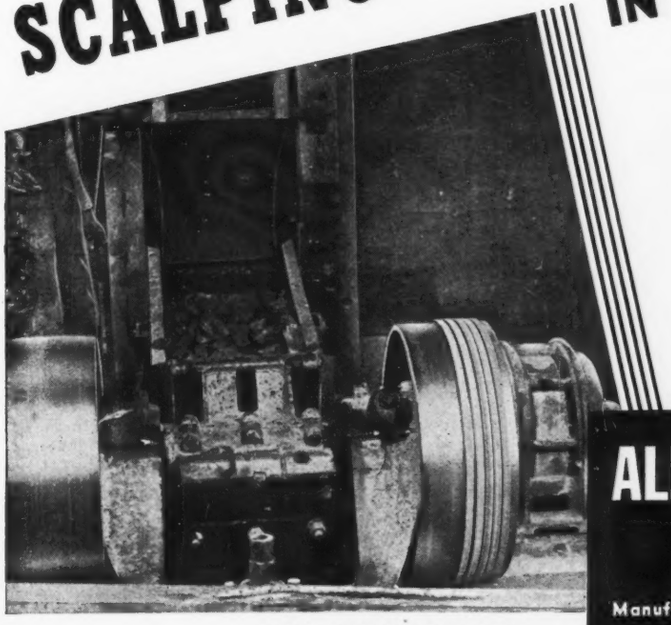

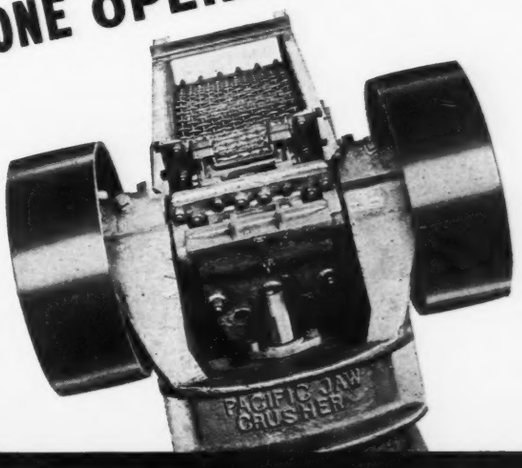

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T.N.E.C. Studies Copper

Inquiry covers experience in the production and marketing of the metal since the World War, particularly with respect to periods of national and international cooperation

OPENING a broad study of the cartel form of industrial organization, the Temporary National Economic Committee held public hearings on the subject throughout the week of Jan. 15. Particular attention was given to the United States copper industry as illustrating the essential features of national and international cooperation among industrial units. Witnesses for the copper industry comprised Cornelius F. Kelley, president, Anaconda Copper Mining Company; E. T. Stannard, president, Kennecott Copper Corporation; and Francis H. Brownell, chairman, American Smelting & Refining Company. Arthur Notman, consulting mining engineer, New York, appeared as an expert witness for T.N.E.C.

The hearings opened with a statement on cartels prepared by Theodore J. Kreps, economic consultant for T.N.E.C., who traced the development of these organizations abroad. Cartels exist mainly in those industries in which there is a concentration in few hands of natural resources, capital, markets, or patents. They thrive best in times of economic distress and tend to break up in boom times.

To illustrate the concentration of control of copper production, exhibits were introduced by T.N.E.C. counsel showing the organization, subsidiaries, and affiliates of Anaconda, Kennecott, Phelps Dodge, American Metal, and American Smelting. It was shown that in 1937 the first three of these accounted for nearly 80 per cent of the mined copper production of the United States.

Mr. Kelley was questioned about the various forms of cooperative activity among domestic producers: Copper Producers Committee, Copper Export Association, Inc., Copper Exporters, Inc., and Copper Institute.

Sales to Army and Navy

Copper Producers Committee was organized prior to the entry of the United States into the World War to deal with the War Industries Board in supplying copper to the Government. With copper then selling at 31¼c. per pound, the Committee furnished the Army and Navy with 45,000,000 lb. at 16.67c. per pound, the average price for the preceding ten years. Subsequent sales also were made below the prevailing price.

Copper Export Association, Inc., 1919-23, and Copper Exporters, Inc., 1927-32, were both formed under the Webb-Pomerene Act permitting combinations of domestic producers to fix prices for export trade only in order effectively to meet concentration of buying power abroad. Copper Export Association aided in the orderly liquidation after the war of a copper pool of 200,000 tons against which a loan of $40,000,000 was obtained, secured by debentures that were retired as the copper was sold.

Copper Exporters, Inc., differed from Copper Export Association in that the former included foreign as well as domestic producer members. Its purpose was to try to eliminate speculation in copper abroad that caused wide fluctuations in price without regard to industrial demand.

Copper Institute is a statistical agency that gathers and publishes data on world production, distribution, and consumption of copper. Its occasional failure to publish statistics was under some implied criticism by members of T.N.E.C.

Mr. Kelley stated that all these cooperative activities had been under the constant scrutiny of some Federal agency, and that the copper producers had strictly observed the anti-trust laws. Asked for his views on industry cooperation, he said that members of an industry should be allowed to meet and discuss their problems without facing criminal action in the courts; that minutes of meetings should be filed with the Government, open to inspection of press and public; that the consuming public might be represented by the Government in these discussions; and that some way must be found to relieve industry of the burden of narrow prohibitive restrictions of a statute passed fifty years ago and no longer applicable to modern industrial conditions. Mr. Kelley referred to the sort of cooperation accorded agriculture under the Capper-Volstead law. He felt that some form of *supervision* of industry by Government, rather than constant *regulation*, would make possible the more orderly conduct of business.

Other testimony of Mr. Kelley related to prices, production costs, the shutdown of 1921, and the curtailment agreement of 1930-31. He ascribed the rise in price of copper in 1928-29 to general economic conditions and not to controls exercised by Copper Exporters, Inc. He explained the 18c. plateau that prevailed for several months after the crash of November, 1939, as an effort to cooperate with the Government, which, through the President, had urged all industries to try to prevent a collapse of prices and employment. He felt that the price was fictitious and artificial, and said that it was continued against his better judgment.

Mr. Stannard testified regarding N.R.A.; the international agreement on production control, 1935-39; the attitude of the copper industry on speculation on metal exchanges; and fluctuations in prices, production, and shipments.

Under N.R.A. the copper industry was unable to agree on a code, and was dissatisfied with the one that was imposed. The industry was opposed to an extension of N.R.A. and felt that some other form of cooperation on production and price would be preferable; as, for example, the Capper-Volstead law.

The international agreement of 1935 was between the South American and Mexican subsidiaries of Anaconda and Kennecott; Mufulira, Roan Antelope, and Rhokana of Rhodesia; Rio Tinto of Spain, Katanga of Africa, and Bor of Yugoslavia. These companies controlled about 50 per cent of foreign production of copper. The purpose of the agreement was to help stabilize production, distribution, and marketing of copper outside of the United States. A quota system allotted production curtailment based on standard tonnages for each producer. There was no price-fixing or allocation of territory. The 4c. excise tax on copper imported into the United States prevented foreign producers from entering that market. In view of this fact, Kennecott adopted the policy of not exporting much copper.

Mr. Stannard expressed the opinion that speculation in copper on metal exchanges is partly responsible for fluctuations in price, and that the copper industry disapproves of it. During the boom of 1937, he understood, speculators on the London Metal Exchange bought between 100,000 and 150,000 tons of copper. Counsel for T.N.E.C. introduced an exhibit showing that trading in copper futures on the New York Commodity Exchange had increased from 6,132 tons in 1929, when copper trading began, to 537,880 tons in 1939.

In the matter of prices, production, or curtailment, Mr. Stannard stated that there was no agreement or understanding among domestic producers. Each followed his own best judgment. He did not believe that a futures market would stabilize buying; and he deplored the buying waves to which the industry is subject, but saw no immediate way to avoid them.

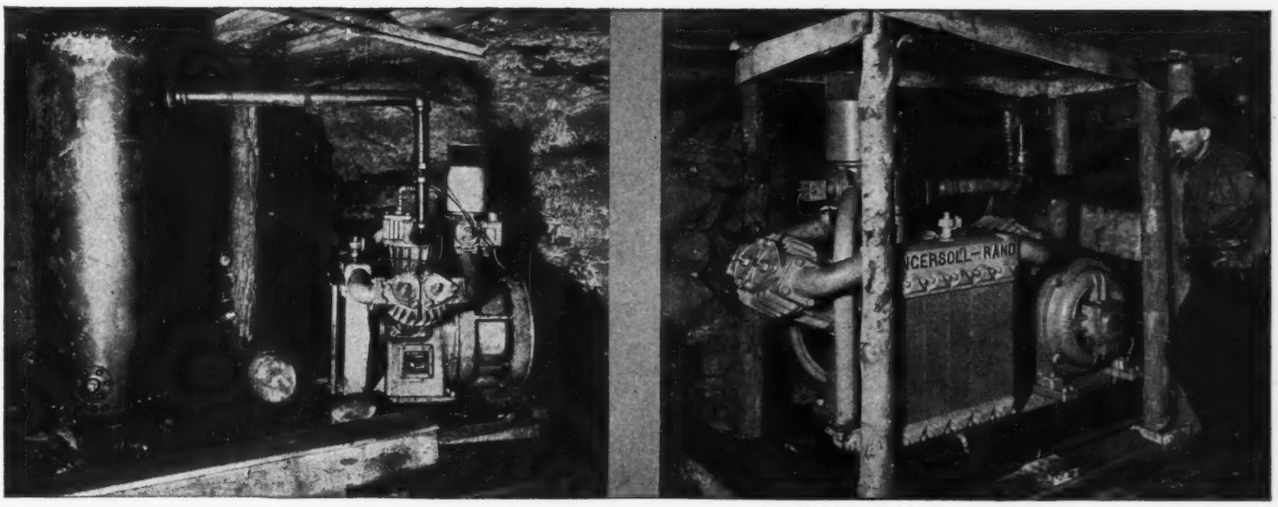
Copper and Lead

Mr. Brownell explained that although A.S.&R. owns no copper mine of consequence, nevertheless that metal is important in its business. His company is essentially the smelter and refiner for numerous small producers that cannot treat their own ore. He elaborated the marketing policy of the custom smelter, which is generally to sell each day its intake of metal.

Marked differences between the lead and copper industries noted by Mr. Brownell were: (1) that the lead producers have no fabricating subsidiaries of consequence, and (2) lead is sold for 30 days delivery as against 90 days for copper. Furthermore, the practice of copper producers in protecting customers and fabricators for 24 hours against announced price rises undoubtedly accentuates buying waves in that metal.

Mr. Notman confined his testimony to the economic aspects of the copper industry. He advocated the Finlay formula for ascertaining the cost of production: deduct from gross income the amount distributed in bond interest and dividends. The remainder is the true cost. On this basis a group of about twenty foreign and domestic copper producers had an average cost during the period 1926-32 of 9.63c. per pound of copper. The *E.&M.J.* average

(*Continued on page* 118)



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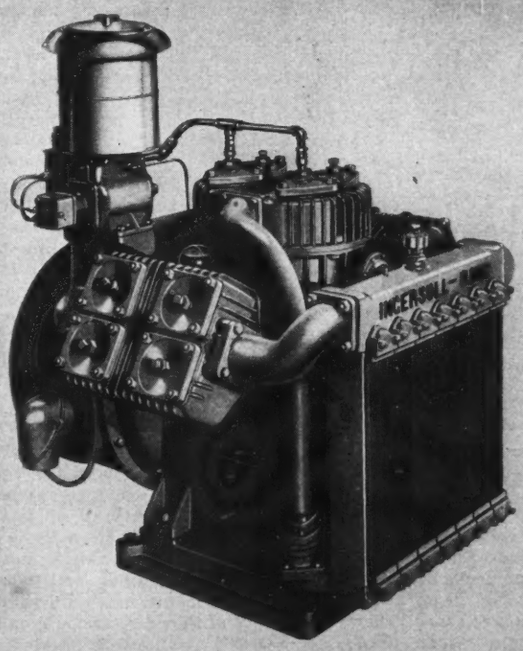

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NEWS FROM Washington

By Special Correspondent

ECONOMY is safe politics. This appears to be the new slogan of Congress as its January effort on appropriation bills begins. In its simplest terms, this means only that there are more taxpayers who vote than folks who want something more from the Federal Treasury. Thus Representatives from many parts of the country find that it would be safer to vote for curtailed spending rather than for new taxes or the increasing of the national debt limit.

Most mine industry executives can find some comfort in this situation. It probably means, though any forecast is only a thoughtful guess, that new income tax levies are not likely to be placed on either corporations or individuals this year. Only by economy will such a plan be workable. The third possibility, increasing the public debt limit above $45,000,000,000, is not likely to be exercised this year. That change, which doubtless will have to come later, will be left for the post-election Congress to face.

Bureau Reorganization

THE forced resignation of Dr. Finch as Director of the Bureau of Mines was only one step in a plan of Secretary Ickes to reorganize that Bureau. The issue appears to be whether the Bureau of Mines can be continued as a fact-finding technical and economic agency. The Secretary wishes to use it in other ways, notably as a reform and regulatory body.

At one stage of the reorganization effort it was apparently planned to abolish a number of important posts in order to eliminate Civil Service appointees. Then the functions previously exercised by these men would be re-established in positions of different title. That system of overriding the protection for career officials under the Civil Service system was, however, abandoned. It was discovered that the executives could abolish the positions by this method but that they could not establish new posts without the approval of the Civil Service Commission. And that body was put on the alert by the attack against it in the original discharge of Dr. Finch by the Secretary.

Other methods of changing the administrative set-up were, therefore, adopted. Charges have ranged from disloyalty to outright dishonesty. Sherlock Holmes has no more amazing incidents than some which appear to have transpired within the Department of the Interior during January. Gossip has it that doors were jimmied, files searched, and the most picturesque sleuthing methods undertaken.

The resignation of Dr. Finch was effective Jan. 31, but he remains on the payroll until March 15 in order to grant him his accrued leave. The assistant director of the Bureau, Joseph H. Hedges, has been relieved of his duties in that position, and from his post as chief of the administrative branch he has been transferred to a minor engineering position at the College Park, Maryland, station of the Bureau. Pending the naming of a new director, an assistant director. or other disposition of the Bureau problem, Dr. Arno C. Fieldner, chief of the technologic branch, has been named acting director, and James W. Furness, chief of the economics branch, has been named acting assistant director. Temporarily, J. A. Davis is acting as chief of the administrative branch for routine matters.

The first week of February furnished numerous rumors as to a complete dismemberment of the Bureau. Such plan has undoubtedly been proposed to Secretary Ickes, but it is certain that there will be many political, as well as administrative, factors to be considered before the following modified set-up will be put into effect, if ever. Under this plan, all coal work would go to the Bituminous Coal Commission, all petroleum work to the Petroleum Conservation Division, all safety work to the Public Health Service, and the remaining technical and economic studies on metals, non-metallics, and other minerals would be transferred to the United States Geological Survey. The mining industry would, of course, fight such dismemberment and a major political battle on Capitol Hill would follow if the Secretary recommends and the President accepts such a plan.

Mining Security Forms

SIMPLIFICATION of procedure for securing new money for mining enterprises is part of the objective of Securities and Exchange Commission. This Government agency recognizes its service responsibility to the mining enterprise of the country quite as much as its duty to police security issues so that they may not be fraudulently foisted on unsuspecting purchasers. Two types of procedure are being developed at present that will, it is hoped, aid in further transactions. One will be used by the development or exploratory unit in registering securities. The other form will be applicable to established mining enterprises needing larger sums when the company is a simple corporate structure and is dealing directly with the primary enterprise.

Executives of SEC point out that needless complication in registration forms or reports may do more harm than good. It sometimes even lends to the development of a sort of legal practice which imposes an unnecessary burden on the mining company which is overawed by the complicated form and thinks that it needs some "experienced man" to care for its project. More direct contact with SEC in Washington, or at the regional offices like Denver, San Francisco, and Seattle, is being encouraged, to eliminate burdensome attorneys' fees where such special skill is not required. Influential "fixers" are especially discouraged.

The two new forms for mine security registration were being formulated during January, and it is hoped that one or both may be mailed out for comment and criticism by experienced members of the mining industry, perhaps during February. The American Mining Congress and other organizations are also cooperating with the Government in the hope that economical and simple, but adequate, plans can be made for handling even the "highly speculative" development expenditures which are peculiarly needed by small or new mining enterprise. Incidentally, certain new accounting rules which may unify practice in many divisions of industry are also being considered by SEC.

Mine Labor Policy

LABOR wants a larger slice of the gross income of mining. In this regard it is no different than organized labor in other divisions of business. The philosophy is simple. If the prices of things are higher, then labor should have a greater wage in order to have "its rightful share" of the total income of a business.

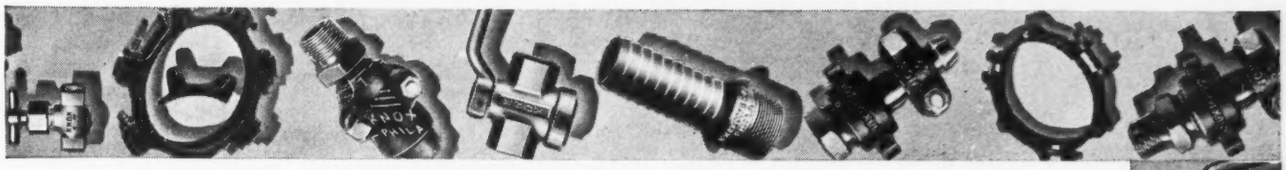
A number of union groups are observed from Washington as using this elementary principle unmodified by factual investigation. But some of the more conservative groups are looking under the surface of price increases. They are trying to find out how much may be caused by increased raw material charge, increased transportation expense, and other increases in cost not traceable to labor. These conservative groups are advising their subsidiary unions and the membership that it is not always timely to ask for a wage increase when the market price of the goods goes up.

Official Washington does not play up the international factor in increased costs very conspicuously in its discussion of wage questions, but generally the career divisions of the Government are giving factual support to the more conservative labor leaders. They have a selfish motive in this. They believe that too many strikes or too much other labor disturbance will be unsettling to business and make it more difficult for present authorities to continue in office. This is just a minor variant of the general necessity for a profitable 1940 if the Democrats are to continue in power.

Federal Mine Inspection

AS THE SENATE passed the Neely bill, it provides authority for the Secretary of Interior to conduct annual or more frequent inspections of coal mines. The Senate refused by a technicality of procedure to extend this authority to include metal mines and non-metallic mining operations. Furthermore, it merely authorized, and did not order, the Secretary to take such periodic action as is prescribed for coal mines.

Passage of this measure represents a real victory for John L. Lewis, of United Mine Workers. His group is expected to continue its most energetic effort for approval in the House also. Some feel that the Administration does not look kindly on any such enactment as would increase the prestige of Lewis in an election year. Thus lukewarm backing is forecast, even though under other



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circumstances the President would be likely to support this desire of Secretary Ickes. State officials resenting Federal interference in their jurisdictions are expected to continue opposition, perhaps more effectively, in the House.

Metal-mine owners are being urged to take a hand, since it is obvious that enactment of such a measure for coal mining would invite comparable mine inspections by the Federal Government in metal and non-metallic operations.

Aluminum But Not Steel

BONNEVILLE POWER will be used for making primary pig aluminum under an arrangement between Aluminum Company of America and the Secretary of Interior. A twenty-year power contract for 32,500 kilowatts was announced about New Year's. This means real metallurgical activity at the new reduction plant to be built near Vancouver, Wash.

But other announcements of Secretary Ickes regarding Western metallurgical opportunity for steel making are not supported by comparable contracts or similar prospect of immediate development. At the moment they have the backing only of wishful thinking which culminated in a report by the Bonneville Project to the Secretary, important portions of which were released by him during mid-January.

In essence, this report justifies its hope for such a steel plant and rolling mill "in view of the availability of low-cost power . . . and ready availability also of the essential raw materials." Success would be assured, "if the operation were tied into the national defense program" (presumably by subsidy) and could depend upon contracts for marine construction materials or for tin plate for can manufacture.

The Project report further concludes that all materials required are available, citing ore deposits that "may have possibilities" and coals whose suitability is not clearly demonstrated. Electric-furnace reduction is suggested and the use of a wood coke implied. References to scrap-iron supply, high-grade limestone deposits, and other economic factors for construction and operation are unpersuasively vague. But the popular press is encouraged to talk of the proposition as though it were an assured fact.

Procedural Reforms

CONGRESSIONAL investigations of NLRB may lead to fundamental changes in Washington philosophy more important to mining than are the most harassing of the past practices of the Labor Relations Board. Congress is much impressed by the information disclosed through the hearings of the special House committee. All the lawyers of Congress are noting with concern the extra-legal procedures which have been set up, apparently with approval of Congress.

Proponents of reform are particularly anxious that one of the main results shall be a limitation on the authority of administrative bodies of this sort. It is rather doubtful in the early weeks of the present session of Congress whether the National Labor Relations Act will be extensively revised this year. Far too many folks think that it has been the administration of the law, not the law itself, that has caused most of the difficulty. Such an attitude leads to the double-barreled conclusion. (1) The membership of the Board should be changed and (2) changes in the law should be postponed until an intelligent handling of the old law identifies points of strength and weakness.

A few months ago no one thought that there was any chance of enactment of a general law establishing an Administrative Court of Review. Now it looks as though that bill might move on quite a way toward enactment this year. The purpose of such a Court, if established, would be to review the findings of administrative bodies like NLRB, Wage Hour Division, and numerous other executive agencies before the findings or rulings should have the effect of law. At present many of these rulings are not subject to court review, but must be accepted by the courts as correct with regard to actual findings of fact. The new legislative effort is being strongly encouraged by mining and business spokesmen who recognize that the prospective relief from arbitrary executive officers might be more important than relief from burdens of the present labor law. The latter would come later where needed, they hope.

Stop Export—or Else!

THE exporting by speculators of certain strategic materials, including important metals and minerals, still disturbs the Army and Navy. Therefore, on Jan. 19 Secretary Edison and Assistant Secretary Johnson issued a joint statement about abnormal exports to Europe of crude rubber and pig tin. The concluding paragraphs of that statement clearly indicate an intention to ask for legislation, which can probably be had, if the re-exports "might weaken the national defense position of the United States." The Secretaries said:

"While the more patriotic and responsible dealers and manufacturers in the United States are cooperating with the Army and Navy Munitions Board in its effort to maintain an adequate supply of these materials in the United States, others, apparently through a lack of appreciation of the situation, or for other reasons, are continuing to engage in export activities detrimental both to the industrial economy of the Nation and to the national defense.

"The War and Navy Departments believe that unless the method of voluntary cooperation can be counted upon to operate with complete effectiveness, it will become necessary to use other means to deal with the situation which has developed with respect to the export of crude rubber and tin."

News "Fines"

Mines Bureau Money—Appropriations recommended by the Budget Bureau for the Bureau of Mines for the next fiscal year are substantially the same as last year's appropriations. The small increase recommended for the Economics Branch would provide merely the necessary funds so that the travels of the joint representative of the Bureau and the State Department could be continued in Latin America for regular reports on mineral trends and developments.

Depletion Allowances—Mine executives in making their next returns on corporation income will be guided by a new rule regarding the division of depletion deductions in accordance with the ownership of economic interest in mineral deposits. This new regulation promulgated the first week of January sets up a specific ruling as to how much allowance may be taken under varying circumstances where multiple ownership or economic interest exists. (Treasury Decision 4960 covers this case.)

Trade Agreements—Several months of bitter Washington controversy is expected before Congress decides whether to extend for another three years the unrestricted authority for trade agreement negotiation. Even during the Supreme Court "packing" battle the Administration did not put forth more vigorous effort that it is now exerting for the unrestricted continuance of Secretary Hull's authority.

Mining in the Parks—Secretary Ickes' action in opening certain national park areas to mine prospecting is causing deep concern in Washington among the conservation groups. The gossip that the Forest Service is to be transferred from Agriculture to Interior adds further to the worries of recreation, Isaac Walton, and other groups. Some even claim that stream pollution legislation will be delayed, if not prevented, by the desire of those who would "despoil the public recreation areas" by mining, milling, and smelting.

New Manganese Bids—The Procurement Division of the Treasury Department on Feb. 1 requested new bids to be opened Feb. 20 for a ferro-grade manganese ore. Offerings of any quantities from 2,000 to 45,000 tons will be acceptable under specifications comparable with those previously used. The last previous request of the Government for bids was opened Dec. 19, but no awards were made under those offerings, as none gave the Government any advantageous quantities or prices. The new Schedule S-17, therefore, supersedes all of the rejected bids offered under the proposals of Schedule S-13.

Fort Knox Gold for Tin—The presence in Washington of one of the official Netherlands delegates on the International Tin Committee has renewed official interest in the plans for procuring tin from the Dutch Government. It is believed that the Dutch would be happy to furnish any wanted quantity of that metal "at a price below market." Although no official negotiations appear to be under way, it is believed that the United States could buy this tin with gold and that the gold would not need to leave its burial place in Fort Knox, Kentucky. The Dutch want gold credits for machinery very much and would probably be willing to spend all of the money in the United States for such equipment.

This does not please certain political-minded officials dealing with international matters. They want to retain control of tin, gold, and other matters in order to use them for manipulation of cotton and as a leverage in further trade agreement discussions. Politics and not preparedness will settle the issue regardless of the good intentions and even the generosity of the Dutch.

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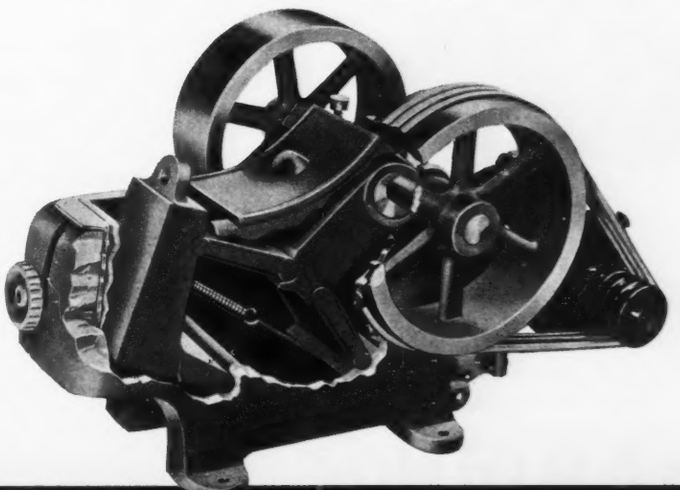

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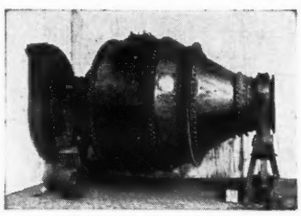

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IDAHO

New Ventilating System For Sunshine Mine

Raises and crosscuts are being driven to facilitate air circulation—Development on 1,900-ft. level of Silver Dollar mine discloses good ore

▶ A system of raises estimated to total 3,000 ft. and 1,200 ft. of crosscuts are nearing completion to permit an increased volume of air circulation for ventilating purposes in the Sunshine mine of the Sunshine Mining Company. The raises will be equipped with steel ladders of hollow skeleton tube design. An eight-blade Aerodyne fan, 5 ft. in diameter, has been installed at the No. 4 tunnel. This unit will be operated by a 50-hp. motor. Completion of the ventilation system is expected in early spring.

▶ Silver Dollar Mining Company, Coeur d'Alene silver belt, is opening a vein of the highest grade silver ore yet found on the property. The discovery was made on the 1,900-ft. level where a vein 4 ft. wide with 12 to 18 in. of tetrahedrite silver-copper ore was uncovered. C. O. Dunlop, Spokane, president, reports plans are being made for a mill.

▶ The Idaho Almaden Mines Company is producing 50 tons of cinnabar ore daily from a new mine opened at Weiser by L. K. Requa, a California mining engineer, in cooperation with a son of Herbert Hoover. The cinnabar outcrop was found in 1936 by a sheep herder. Requa has a 20-year lease and recently completed a retort plant. The ore occurs in opalite and phyolite forms.

▶ Falls Creek Mines, Inc., has completed a new cyanide mill in the Lakeview district. Gold ore is being treated, but it is reported a concentrating plant for lead-silver ores will be erected in the near future.

▶ Betty Lou Mining Company, Burke district, will resume operations at its property adjoining the Gem and Frisco mines, according to J. D. Hodgins, of Gem, president.

▶ Gibbonsville Mining & Exploration Company has started erection of a milling plant on a tailings deposit below the Bunker Hill mill at Kellogg. Tailings are reported to run 3 per cent lead, 3.3 per cent zinc, and 2.6 oz. silver per ton. Tonnage is reported at 130,000 tons. The mill will treat 100 tons a day, according to Walter C. Clark, Kellogg, manager.

▶ The Lucky Boy mine, Mackay district, has been taken over by the Custer Consolidated, Inc., with A. H. Burroughs, Jr., as manager. A mill will be erected, diesel power installed, and pipe lines laid.

▶ The dumps of the Come-Back mine, Pioneerville, are being treated in the 100-ton Enterprise mill at Grimes Pass by John P. Zenz, of Pioneerville.

▶ Lava Manganese Mining Company is mining manganese ore from the old Vanza mine near Lava Hot Springs. A 300-ft. tunnel will be driven to get below the upper levels. Seven men are employed.

▶ Idaho Copper Company is planning to drive a 300-ft. development tunnel on the Red Ledge copper property in the Seven Devils district in Adams County. Air compressors and other machinery are now being installed.

▶ Treasure Vault mine, Hailey, will install a 10-ton gold mill, according to Ralph and H. R. McClure, of Hailey, owners.

▶ Ely-Nevada Mining Company has completed installation of a new 50-ton milling plant at the Center Star mine near Elk City.

▶ In 1939 there were 305 lode mines and 463 placers, a total of 768 properties, operating in Idaho. Arthur Campbell, State Mine Inspector, estimates between 6,800 and 7,000 men were employed in Idaho mines last year, and 50,000 were directly or indirectly dependent on the industry.

▶ Silver Leaf Mines Corporation is making plans for enlarging its milling plant in the Lakeview district. W. M. Cady, Sanpoint, is president, and H. G. Loop, Spokane, secretary.

▶ Liberal King, Pine Creek district, has completed installation of a 200-hp. electric hoist in its new station on the main tunnel level, 4,000 ft. from the portal. Sinking will proceed from the 600 to the 1,000-ft. level with three shifts employed. Henry Weber, of Rose Lake, is manager. C. J. Whittemore, Seattle, Wash., is president.

COLORADO

Miners Meet in Annual Convention

Problems of the industry and their effect on mining in the state are discussed by leaders in the industry

▶ The forty-third annual meeting of the Colorado Mining Association and the Colorado Chapter American Mining Congress was held at the Shirley-Savoy Hotel, Denver, Jan. 26-27. A. H. Bebee, vice-president, Golden Cycle Corporation, was general chairman.

Following the rollcall and addresses of welcome, Robert S. Palmer, secretary, told the convention that Colorado's old-age pension amendment was responsible for keeping "many prominent mining concerns from reopening their properties in this State." In Palmer's condemnation of the State's pension amendment, he remarked that, in his judgment, "no measure has done more harm than the so-called old-age pension amendment." A study of the increased taxes on the mining industry to help support this additional burden would be astounding, he continued. Further, it was time to show the public how the industry was being penalized by new taxes and new Federal regulations. D. D. Potter, of Rocky Ford, in discussing our public land policy and its effect on the future of mining, told the mining world, "That

the effect of revolutionary changes in the national land policy in the last twenty years may be so far reaching as greatly to retard or entirely check the economic development of our public domain." The enactment of these laws centers control more in the Department of the Interior to the detriment of prospectors and miners seeking to stake out claims.

Federal aid in apprehending high-graders was discussed by Albert F. Knorp, San Francisco, representing the Gold Producers of America. Baldwin B. Bane, Director of the Registration Division of the S.E.C. in Washington, told the mining profession that regulations of the S.E.C. on registration of mining securities have been a sore spot with hard-rock miners, but were being revised for "simplicity and clarity" in favor of the small operator.

Francis A. Thomson, president, Montana School of Mines, presented "The Future of the Mineral Industry" at the silver banquet. Vast possibilities for development of the mineral industries are seen by Dr. Thomson. Instead of being on the down grade, the mineral industry has only begun to scratch the surface of its most important field, the development and utilization of new alloys which will make life of the future as different from life today as the bronze age was from the era of bone implements.

National legislation and policies affecting the mining industry took the spot light in Saturday morning's session, as Julian D. Conover, secretary, American Mining Congress, reviewed the situation in Washington. He charged that the Administration's reciprocal trade agreement policy has harmed the mining industry tremendously and has yielded no corresponding benefits. The solution of the dust problem by the mining and milling industries was presented by Donald E. Cummings, associate director of the Saranac Laboratories. A motion picture "Methods Used to Deal Successfully With Dust Problems in Canadian Mining and Milling Operations," produced by the Ontario Mining Association, did much to clarify this problem. "Ground Movements and Subsidence," was discussed by J. Burns Read, head of the Department of Mining, Colorado School of Mines. A paper, "Spectrographic Analysis of Ore," was presented by C. C. Nitchie, Bausch & Lomb Optical Company.

Technical papers were interspersed with moving pictures: A sound movie "Canadian Gravels," produced by the Canadian Government; and a color movie, "Molybdenum in Iron and Steel," with particular reference to its application to the mining industry, through the courtesy of the Climax Molybdenum Company. Jesse F. McDonald was selected to head the Colorado Mining Association, with Robert S. Palmer, secretary; Shrive B. Collins, treasurer; George E. Collins, first vice-governor; and John T. Barnett, second vice-governor. The annual sow-belly dinner was attended by fifteen hundred and was a grand climax to an excellent mining convention.

▶ The Blue Jay, Emmett, Argo, and Brown Spar group in the Jamestown area are being opened up by the National Fluorspar & Chemical Company, of Boulder.

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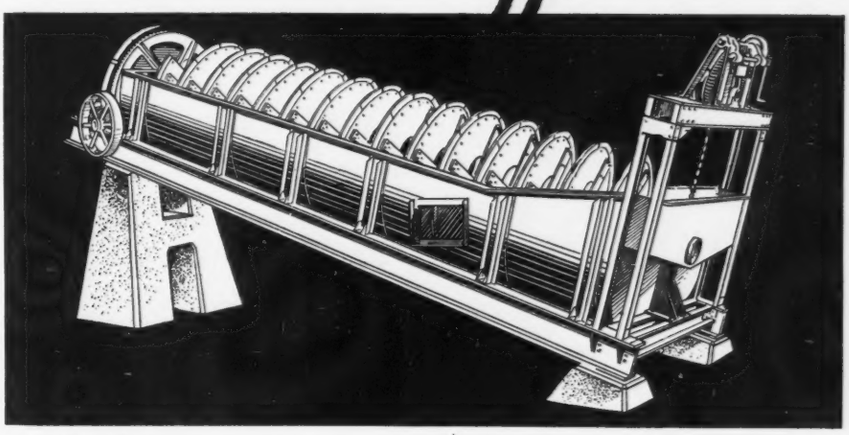

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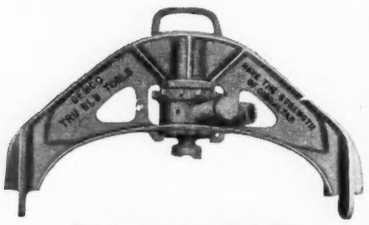

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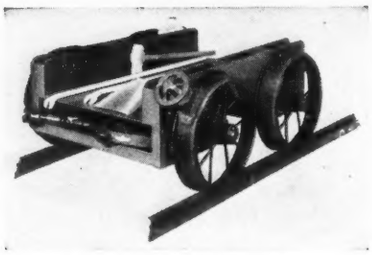
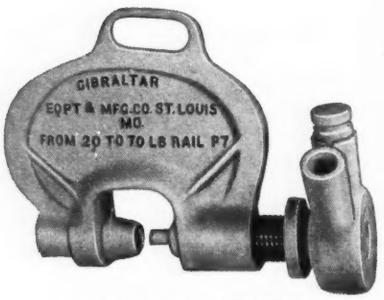


MINERS' TOOL CAR



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Tintic Standard Mining Company, at Dividend, Utah, was one of the leading silver producers in the State during 1939. The company practices filling old slopes with clay slimes

UTAH

Diamond Drilling Reveals Gold-Bearing Horizon

Hole from bottom of shaft of the Mercur Dome Gold Mining Company's mine locates gold- and silver-bearing Madison limestone—Silver Prince Mining Company reports finding new ore

▶ C. N. Sweet, vice-president and general manager of the Mercur Dome Gold Mining Company, announces that the company is extending its shaft about 135 ft. as the result of discoveries made by core-drilling. From the bottom of its shaft, 370 ft. on the incline, the company drilled 585 ft. At 126 ft., gold ore was found and at 543 ft., the important Madison limestone was located. The cores from this formation carried $8.43 in gold and 2 oz. of silver to the ton.

▶ The contract for driving a 500-ft. incline to explore the Madison limestone in the north end of the Dry Canyon area has been awarded by the Ophir Queen Mining Company to William Dimunche. The incline has been started at the face of the west drift from the shaft of the adjoining Madison Mines Company. D. H. Vincent, Utah Oil Building, is president of the Ophir Queen Company.

▶ Mining men of the State are expecting that operations at many properties will continue on a steady basis in 1940. With silver pegged at 71.11c. an ounce and gold at $35, the search for new mines will naturally turn in the direction of deposits carrying these metals. Reserves of producers in the silver-lead camps assure excellent production, if prices are fair. Utah Copper, of course, has a sufficient tonnage to carry on for decades. Its production will depend on the stability of the metal market.

▶ The Mammoth Mining Company, operating Tintic's oldest property, started the new year by paying a dividend of 5c. a share or a total of $20,000 on Jan. 2 to stockholders. During the Christmas holidays, Silver King Coalition Mines paid 15c. a share, or $183,000; and Tintic Standard, 10c. or $374,825.

▶ Although more mines shipped from the Tintic district in 1939 than in 1938, the total of shipments decreased to 5,053 railroad carloads, compared with 5,232 in 1939. New production resulted from the shipment of a number of old mine dumps for their silica content.

▶ Officers of the Silver Prince Mining Company—Dr. Hugh B. Sprague, Utah Oil Building, Salt Lake City, president—report that a 3-ft. face of commercial ore has been opened in the Humbug formation of the company's lease.

T.N.E.C. Studies Copper

(*Continued from page* 110)

price for the same period was 13.19c. per pound. Noranda had the lowest cost, 5.22c. per pound.

The effects of technological improvement in the industry were reflected by an increase in production of 70 per cent in 1919-29, whereas employment increased only 2 per cent.

As for differentials between the prices of electrolytic copper and certain fabricated copper and brass products, Mr. Notman showed that such differentials had increased markedly in the period 1935-38 and compared with 1909-12. The later, higher-cost period coincided with the ownership of fabricating subsidiaries by the copper producers.

Mr. Notman expressed the view that integration of production and fabricating facilities was unwise for all concerned; also that cooperative undertakings to stabilize the industry had always resulted in higher prices for copper. He was definitely of the opinion that economic laws work as inexorably as those of mechanics, and that no one—individual, group, or Government—is smart enough to evade the consequences of violating them.

Engineering and Mining Journal's prices for copper were frequently referred to throughout the hearings and accepted as authoritative. A sworn statement was introduced into the record showing how *E.&M.J.* quotations are ascertained.

UNITED STATES

(*Continued from page* 60)

Consolidated Copper Corporation, followed closely by Consolidated Coppermines Corporation, both in the Robinson district, White Pine County. The Rio Tinto mine of the Mountain City Copper Company, in northern Elko County, was the third leading copper property in the State.

Lead and zinc from Nevada comes principally from the Pioche district, Lincoln County, where the Combined Metals Reduction Company is the leading producer. This district, according to the Bureau of Mines, accounted for over three-fifths of the lead production and over nine-tenths of the zinc produced in the State in 1939.

UTAH—Three metals, gold, silver, and copper, showed substantial increases in Utah's production in 1939. Lead and zinc, however, declined due to decreased activity early in the year and suspension of operations at some properties.

Gold output increased from 200,630 oz. in 1938 to 276,060 oz. in 1939, the largest producer being the Utah Copper mine, in the Bingham district, followed by the Consolidated Mercur mine of Mercur, the United States & Lark property at Bingham, the Tintic Bullion, and the Geyser Marion mine.

Silver production increased from 9,682,732 oz. in 1938 to about 10,574,987 oz. in 1939. The leading producer was the United States & Lark property, followed by the Tintic Standard, Utah Copper, Silver King, Coalition, Park City Consolidated, Ophir Hill, and Chief Consolidated. In the Tintic district the Bureau of Mines reports a decrease of about 402,000 oz.

Copper totaling about 170,520 tons was produced in the State during 1939, compared with 108,126 tons in 1938 and 205,994 tons in 1937. The Utah Copper Company mine produced nearly all the increase from its open-cut mine at Bingham, expansion occurring from September to the close of the year. At one time during the last quarter, production at this property is believed to have reached about 385,000 tons of ore per week. Other mines contributing to the State's copper output included the United States & Lark, Ohio Copper, and Boston Consolidated properties, at Bingham.

Lead production declined in 1939, chiefly due to decreases at the United States & Lark, the Tintic Standard, Park City Consolidated, and Park Galena mines. Total lead production was 65,413 tons in 1939, against 65,657 tons in 1938. Most of these same properties reported decreases in zinc output. The zinc production for 1939 was 33,357 tons against 33,658 tons in 1938.

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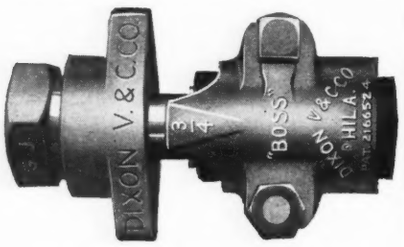

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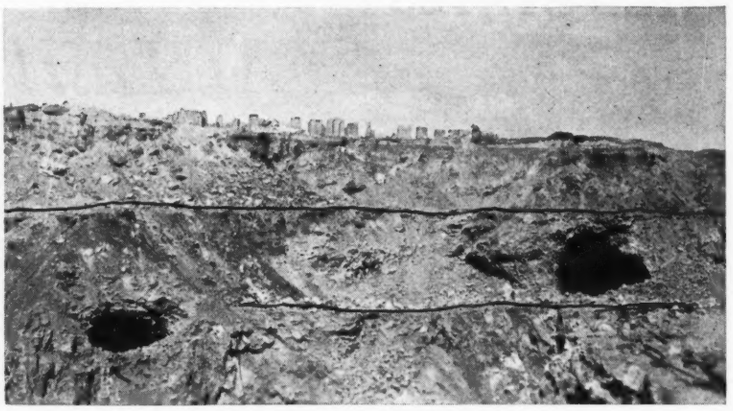

Present benches of the open cut operations of the Mutual Mining Company, Mo., are shown by the dark lines. Care must be taken to avoid breaking into the old underground workings.

TRI-STATE

Further Drop in Zinc Price Closes More Mines

Several properties forced to suspend operations due to extreme cold weather—Federal Mining & Smelting Company closes Jarrett and Muncie properties

▶ Production in the Tri-State district has been reduced to an average of less than 6,000 tons of zinc concentrates per week during January. Because of slack demand, many operations extended their shutdown period for several weeks after the holiday period and a number have suspended operations indefinitely. Several weeks of extremely low temperatures forced further suspensions until at one time only eight mine mills and one tailings re-treatment mill were in operation. During the last few weeks of the month only 36 mills were operating intermittently, compared with 50 mills in November and December. Stocks in bins have been greatly reduced during January, but because of several factors future demand is uncertain.

▶ The Dines Mining Company suspended operations at its mines and mill just north of Picher, in Kansas, late in December, throwing 100 men out of employment. Inability to sell accumulated stocks of zinc concentrates was given as the reason for the shutdown by H. G. Weidman, company manager.

▶ The Federal Mining & Smelting Company shut down the mines and mills of its Jarrett and Muncie properties, in Kansas, for an indefinite period the first week in January. Approximately 200 men were affected by the shutdown, according to L. G. Johnson, district superintendent of the company.

▶ Howard I. Young, president of American Zinc, Lead & Smelting Company, announces that the Dumas, Tex., zinc smelter of the Peru Mining Company, a subsidiary of Illinois Zinc Company, has been leased by the American Zinc Company of Illinois, and that the plant would be put into production in late January or early February. This plant will treat the zinc concentrate production of the Deming mill and other concentrates that originate in the Southwest. The plant will be operated at capacity of approximately 1,000 tons of metal per month and will give employment to 130 to 150 men. The American Zinc Company of Illinois is a wholly-owned subsidiary of A. Z. L. & S.

▶ Frank Fenix, company manager, announced the indefinite suspension of operations of the F & M Mining Company's mine and mill at Oronogo, Mo., early in January. About 30 men had been employed at this operation.

▶ Approximately 26 men lost their jobs early in January when the Eunamar Mining Company suspended operations.

Mining Congress Annual Meeting

THE FORTY-SECOND annual meeting of the American Mining Congress held in New York on Jan. 18 resulted in the election of officers for 1940, and publication of a declaration of policy on matters affecting the mining industry. Strong opposition was registered against the reciprocal trade treaty program now in effect.

Election of the following officers was announced: Howard I. Young, president of the American Zinc, Lead & Smelting Company, reelected president. Vice-presidents: D. D. Moffatt, vice-president, Utah Copper Company; Donald A. Callahan, attorney, Wallace, Idaho; and E. B. Greene, president, Cleveland-Cliffs Iron Company. Julian D. Conover was reelected secretary. Directors elected for a three-year term were: Arthur E. Bendelari, Eagle-Picher Lead Company, Cincinnati, Ohio; D. D. Moffat, vice-president, Utah Copper Company, Salt Lake City, Utah; Harry LeRoy Pierce, M. A. Hanna Company, Cleveland, Ohio; Charles H. Segerstrom, president, Nevada-Massachusetts Company, Sonora, Calif.; and J. B. Warriner, president, Lehigh Navigation Coal Company, Philadelphia, Pa.

MONTANA

Low Temperatures Force Suspension of Work

Several properties to resume operations in the Spring—Silver Cable mine, near Idaho-Montana border, may be reopened

▶ Severe weather conditions are responsible for temporary shutdowns at several Montana properties. The list is incomplete, but among those reported are several mines in the Libby-Troy area and the Norwegian Creek dredging plant at Norris. W. R. Wade has closed the Branagan mine, at Libby, until spring, when construction of a first 100-ton unit of a contemplated 200-ton milling plant will be started. Also, A. McDonald, who operated the Ella mine, in the upper Trout Creek area south of Phillipsburg last summer, has closed down until spring, when he expects to begin operation of a 40-ton mill now nearly completed. This is an interesting development, as it is in a region in which no active mining has been conducted since early-day placer operations.

▶ It has been announced in Mullan, Idaho, that preparations are in progress to reopen the Silver Cable mine, which is in Montana, but only about ten miles east of the well-known Morning mine of the Federal Mining & Smelting Company of Idaho. An important tonnage of lead-zinc ore of milling grade is blocked out at the mine, but for the present it is understood that arrangements will be made to truck the ore to one of the Coeur d'Alene custom plants. H. H. Miller, of Wallace, O. A. Harmon, of Walla Walla, and George H. McKinnis are reported to be interested in this enterprise.

IRON COUNTRY

Cold Weather Curtails Stripping Operations

Some properties have completed work on their winter program and will not resume operations until spring

▶ Most of the properties operating on the Mesaba range are repairing equipment and doing other work during the winter months. A few properties have stripping schedules, and this work will run well along into the next 60 days. Extreme cold weather has hampered stripping operations as the temperature reached between twenty and thirty below zero. Some mines have completed their stripping operations and are shut down until production will resume in the spring. The various operators expect a busy season during 1940, and if consumption of iron ore runs near the 5,000,000-ton per month mark, operations on the Mesaba range will approach the schedule of 1939.

▶ Consumption of Lake Superior iron ore in December totaled 5,538,374 tons,

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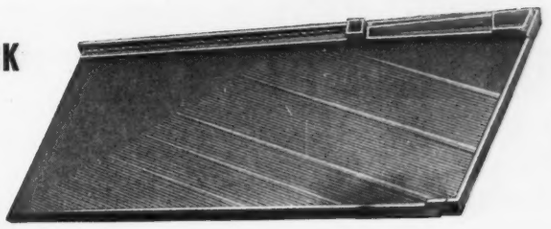

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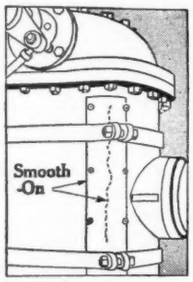
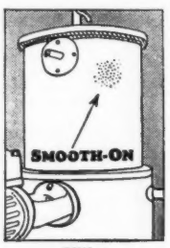
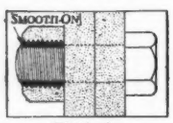


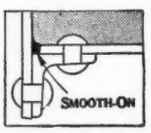
Sealing cracks in pressure parts



Filling porous spots



Tightening stripped threads



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▶IRON COUNTRY

as reported by the Lake Superior Iron Ore Association. Ore on hand at furnaces and Lake Erie docks on Jan. 1 was 37,377,910 tons. The total iron-ore consumption for the year 1939 was 44,361,289 tons.

▶ The price of iron ore for the year 1940 will be the same as in 1939, and prices have now been published for the season's shipments.

MEXICO

Mining Industry Continues Unsettled

Labor disputes and difficulties of many miners' cooperatives, and reduced metal exports to Europe, contribute toward uncertain outlook

▶ The Mexican mining situation showed no improvement in mid-winter, though there were settlements of labor conflicts that could have had disastrous results. These settlements were costly to the companies. Asarco was refused permission to close its refinery at Matehuala, San Luis Potosi State. Small-scale miners urged abolition of the 12 per cent tax on exports at their third annual convention in Mexico City, Jan. 29 to Feb. 3. It is interesting to note that gold and copper production show increases, but that of silver has dropped, and that exports continued to Germany and Poland as late as September. Exports, however, have dropped off sharply since the start of the war and the Government has complained that the British blockade is withholding shipments of machinery and equipment from Germany.

▶ The cooperative society working properties at Santa Fe de Guanajuato, Guanajuato, that were abandoned by foreign companies or expropriated from them has distributed 50,000 pesos (about $9,500) in profits among it members for the second half of 1939.

▶ The mining industry is in such a precarious condition that it cannot stand legislation which demands less work, the congressional labor committee ruled in reporting unfavorably on a bill presented by Congressman Dr. Adan Velvarde calling for a Federal law for a maximum daily shift for underground mine workers. Valarde argued that this law would increase mining production by from 20 to 30 per cent as it would enable the miners to do better work. The committee held that the eight-hour day is the best and reported that though values of Mexican metals and minerals have dropped 40 per cent in the past decade, the industry's annual expenses have swollen to 81,000,000 pesos (some $15,500,000), apart from taxes. In connection with this bill, Congress was informed that Mexican mining cooperative societies are in such a bad condition that the Government has been forced to increase its annual subsidy to them to 1,000,000 pesos (about $190,000).

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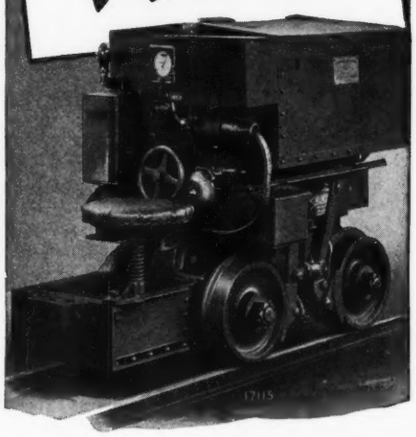

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▶ Unnamed interests, believed to be American, have contracted for the purchase of 1,500 metric tons of iron ore, containing much tungsten and molybdenum, from operators of mines in Tilzapotal, 17 miles from Cuernavaca, capital of Morelos, according to the Ministry of National Economy. The Americans bound the bargain by depositing 300,000 pesos (some $58,000) in a Mexico City bank.

▶ Peñoles is confronted with a new work problem with opposition of workers of its La Bufa and Ojuela y Anexas mines, Mapimi, Durango, urging the Federal labor department to prevent closure of these workings. The miners accused the company of blasting the mines so that work cannot continue. The company denied that charge before the department and said that it is obliged to shut the mines because working them is no longer profitable.

▶ The first embargoing of properties of a cooperative mining society for municipal taxes, the La Verdolaga mine, San Antonio Zomeyucan, State of Mexico, has been protested to the Federal Government by the national miners' union. The society owes two months' taxes.

▶ Asarco lost its long fight to close its copper smelter at Matehuala, San Luis Potosi, an action which it contended was necessary because of unprofitableness, and which had been partly completed, when the Federal Board of Conciliation and Arbitration rejected its application for such authorization. The board ruled that the closure is unjustified. The company had volunteered to deposit in a Mexico City bank enough money to guarantee compensation for dismissed workers in the form of three months' wages each. The national miners' union had stubbornly opposed Asarco's efforts to close the smelter. The board ordered the company to resume work in parts of the refinery it closed or be responsible for the shutdown.

CANADA

Value of Mineral Output Reaches New High

Production capacity of Canada's metal and non-metallic mines has increased considerably since last war—New Helen iron mine increases output—High grade lead-zinc mine reopened in British Columbia

▶ A preliminary estimate of Canada's mineral production last year, by the Dominion Bureau of Statistics, gives a total value of $470,179,000. This is 3 per cent over the 1937 record of $457,359,092 and 6 per cent above the figures for 1938. Gold, copper, nickel, zinc, antimony, cadmium, gypsum, sulphur, lime, petroleum, and natural gas reached all-time record outputs. Metals as a group increased 5 per cent over the record for the previous year; fuels were up 9 per cent to a value of $70,757,000; non-metallics advanced 22 per cent to $24,427,000, and structural materials reached $35,461,000, a gain of 5 per cent. The value of lead in 1939, produced almost entirely in British Colum-

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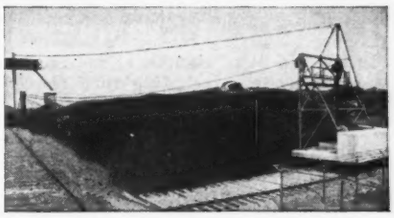
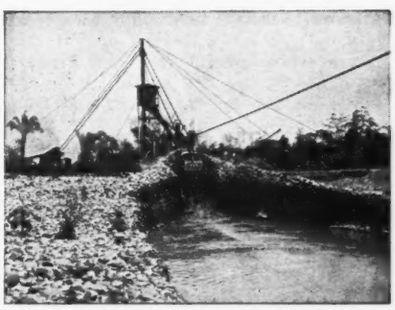


A Sauerman Power Drag Scraper with self-propelled tail tower is widely used for large scale storing and reclaiming at mines, quarries and mills.



Here is a small Sauerman Slackline Cableway digging hard-packed alluvial gravel and delivering to separation plant. Handles 300 tons per day at total cost under $10.

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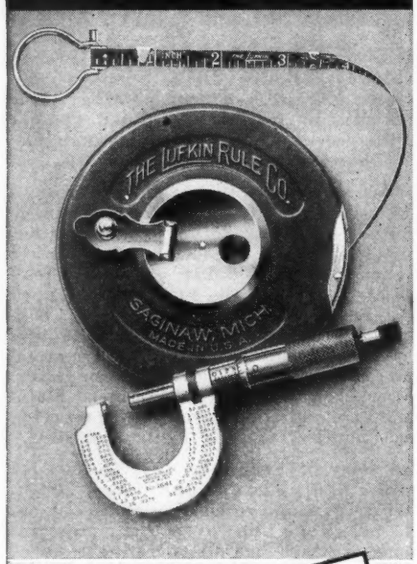

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▶CANADA

bia, was lower than the year before by 12 per cent. The value of Canadian natural resources to the United Kingdom in war time is shown by the great advances made in the last 25 years. Output of the mineral industries in 1914 was valued at $128,863,075, about one-fourth the figure for 1939. Since the outbreak of the World War structural materials and non-metallics, including fuels, have about doubled in value, and metallics have soared from less than $60,000,000 to the 1939 figure of $339,534,000.

▶ News from Thompson-Lundmark Gold Mines early in January enlarges the ore picture and strengthens the belief that this mine will become the third producer of the Yellowknife camp, located 400 miles north of steel. Combined sampling results on the Kim vein show an average of $30.20 for a length of 394 ft. across a width of 1.9 ft. The Fraser vein, 3,000 ft. to the north, is being explored on two levels, at 150 and 300 ft. Widths vary from 2 to 2.5 ft. and preliminary sampling is in line with high values disclosed by drilling.

▶ Also at Yellowknife, Negus Gold Mines has been operating a 50-ton mill for twelve months and reports finding satisfactory ore conditions on the second and third levels. J. G. McNevin is general manager and W. Timm is mill superintendent.

Quebec

▶ The Hon. Edgar Rochette, Minister of Mines in the new Provincial Government, has given assurance of legislation "to sweep away all obstructions to the free development of natural resources of the province, and Bill 5 will not be spared." Part of the decline in prospecting is attributed to the useless restrictions of the Natural Resources Act (Bill 5), which went into effect early in 1937. The financial interests that had withdrawn from the province in the last two years will now be invited to return their support.

▶ A report on Arntfield Gold Mines has been prepared by Dr. J. E. Gill, consulting geologist of Montreal, following a detailed study of the property. Several well-defined breaks favorable for ore deposition have been described and two of them are being explored by a drilling program that started in December.

▶ Encouragement has been found in depth development at McWatters Gold Mines, 5 miles east of Noranda, on four new levels opened in the No. 4 shearing. Gold enrichment occurs in steep cross-fractures along both north and south contacts of a narrow belt of conglomerate. W. J. Hosking is general manager.

▶ The Cournor Mining Company, under the management of Dr. F. C. Buckland, has been successful in opening two new veins in workings from the Beaufor shaft and is crosscutting on the 600-ft. level.

Ontario

▶ Paymaster Consolidated Gold Mines, in the Porcupine camp, has opened 1,353 ft. of new ore in recent development work on the 1,725 level. Widths average

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PAE

5 ft. and the grade is about $8.75. A new vein has been reported on the 1,050 level in an unexplored area where detailed study may show conditions better than mine average. Diamond-drill intersections at the 2,075-ft. horizon suggest the downward continuation of the new vein, which is next to be tested above on the 600 level. A plant for treating old tailings went into operation on Jan. 15.

▶ Algoma Ore Properties, the Algoma Steel subsidiary operating the New Helen mine, near Michipicoten Harbor, Lake Superior, loaded the first boat with sinter on Aug. 12. Up to the close of navigation on Dec. 2, approximately 65,000 tons had been shipped in eleven ore boats to the steel mill at Sault Ste. Marie. Loading equipment has been installed with a capacity of 300,000 tons per navigation season, and there is provision for dubling this rate if required. The light-weight ore is hauled 8 miles in 56-ton capacity steel cars from the sintering plant at Wawa to the loading basin at the Harbor, where a system of conveyor belts can load 6,500 gross tons into a vessel in 5½ hours. Mine production is at the rate of 1,800 tons a day and is being stepped up to the rated capacity of 2,000 tons.

British Columbia

▶ Satisfactory development is recorded at the Privateer gold mine, in the Zeballos area. No. 2 vein, on the second level, which is parallel to and on the same level as the 800 level on the main vein, has disclosed good ore for the last 60 ft. According to D. S. Tait, president, this has averaged 2.7 oz. of gold over a width of 8 in.

▶ Production from the new mill at Central Zeballos was begun on the first day of the new year and is expected, according to W. A. Sutton, secretary of Reno Gold Mines, which have a controlling interest in Central Zeballos, for the next few months to be approximately $25,000 monthly. The mill is of the amalgamation-flotation type and has a rated capacity of 25-35 tons daily.

▶ The strike situation at the pioneer mine, in the Bridge River district, has shown no improvement since the mine was closed Oct. 8 last. During the last two weeks of December tentative efforts were made by the management to come to some agreement with their employees, but, shortly after the resumption of negotiations, new proposals were submitted by the local branch of the C.I.O. affiliate, the International Mine, Mill and Smelter Workers' Union. Dr. Howard T. James, managing director of Pioneer, has refused to accept these new terms, on the ground that they offer only a temporary peace and would provide no lasting settlement. In contrast to this, the labor force at the adjoining Bralorne mine recently affirmed its faith in the local Co-operative Committee, a vote as to whether this organization should act as bargaining agent for the workers giving a majority of 316 over 131 in favor of the proposal. Since this result was achieved in spite of pressure on the employees brought to bear both by the local representatives of the C.I.O. and the Co-operative Commonwealth Federation—both of which

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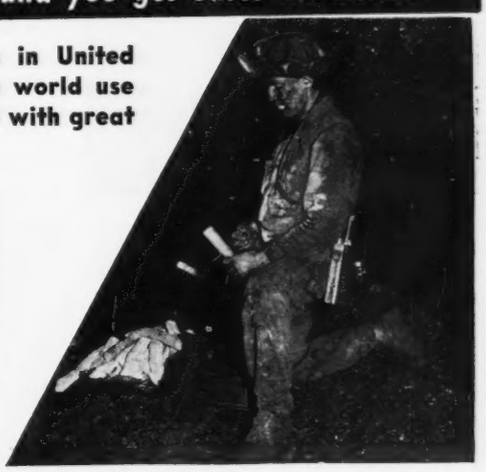

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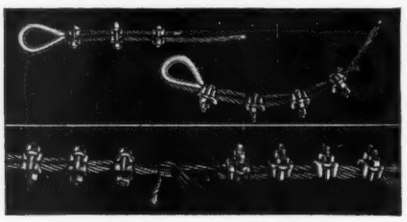

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▶CANADA

bodies favor international unionism—it is regarded on the Coast as a victory for moderate labor against the extremists.

▶A new placer mine, to be operated by the Cariboo Cottonwood Placers, Ltd., composed chiefly of Washington and Oregon interests, is being developed on the Cottonwood River.

▶The Base Metals Mining Corporation, of Toronto, has reopened the Monarch mine, at Field, which has been dormant for some years, in the expectation that, with the higher prices prevailing for lead and zinc and the benefit to Canadian exporters accruing from the fall in the Canadian dollar, it will be possible to dispose profitably of the Monarch concentrates in the U. S. A. Production began Jan. 15 after some 75 men had been employed less than a month in reconditioning the mine and plant. John D. Galloway, recently appointed manager, reports that although early milling will be slow, he anticipates a daily production of 250 tons within a month or less. Considerable underground work has already been done. An orebody approximately 500 ft. long varying from 40 to 50 ft. in width and from 15 to 50 ft. in thickness, with a grade of about 12 per cent lead and 16½ per cent zinc, is indicated, though not proved, in the eastern section of the mine. A reserve of about 3,000 tons of broken ore is ready for the mill.

AFRICA

Prospecting For New Gold Deposits Declines

Limit of 150s. per ounce received for gold narrows the interest for financing development of gold properties—Gold coast increases tax on gold exports

▶While earthquakes were shaking so much of the rest of the world, a distinct shock was felt in the Witwatersrand gold district. So far as could be ascertained no damage was done.

▶Witwatersrand mining companies have paid and are paying from the profits of the year just closed the largest total of dividends of all time. Of the 39 companies which have so far announced their dividends, 20 are paying more, 14 the same, and 3 less than a year ago. The total of payments is understood to be between $80,000,000 and $90,000,000.

▶Although hardly any complaint was made at the time it was announced, the policy of the Union of South Africa Government in appropriating everything the mining companies receive for their gold in excess of 150s. per ounce is now coming in for criticism. It is pointed out that it will make large tonnages of low-grade ore unworkable which otherwise could be treated profitably, and that it will further shorten the lives of the half dozen old mines which have at most only a few years of productive life remaining. The claim is also made that

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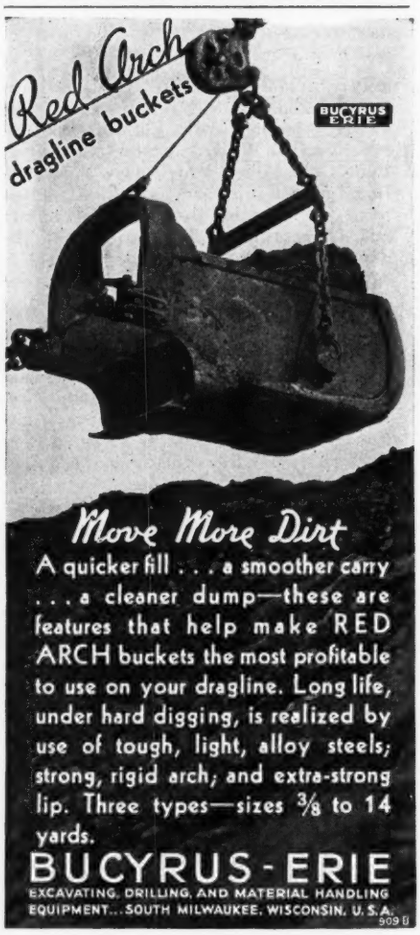
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it will retard the general increase of output, and already is exerting an influence to discourage the development of new producers. Cessation of prospecting activities by a few companies is blamed in part to this, as it is increasing the difficulty of raising new capital.

▶ The tax on gold exports has now been increased by the Government of the Gold Coast Colony, following the lead taken by the Union of South Africa and Southern Rhodesia, but less drastically. The government takes 15 per cent of such amounts as the gold brings above 85s. up to 150s., and 50 per cent of all over 150s.

▶ Kwahu Mining Company has decided to erect a plant of 2,000 tons' per month capacity to treat the ore developed during the past two years on its Siwum property. A profit of £25,000 a year is expected from this operation.

▶ Ariston Gold Mines is proving one of the surprises of the Gold Coast area. Three or four years ago it was regarded by many as little more than a doubtful undertaking, and now, for the year ended Sept. 30 last, its operating profit was £267,602, an increase of £98,198 on the year.

▶ Marlu Gold Mining Areas is suffering a decrease of earnings due to the necessity of treating lower-grade ore. This promises to be temporary, as a considerable extension of its plant will be completed about next March.

▶ Kentan Gold Areas's operating subsidiary, Geita Gold Mining Company, is doing so well that it has been decided to double the capacity of the mill, now 250 tons daily, and pay for the construction out of earnings.

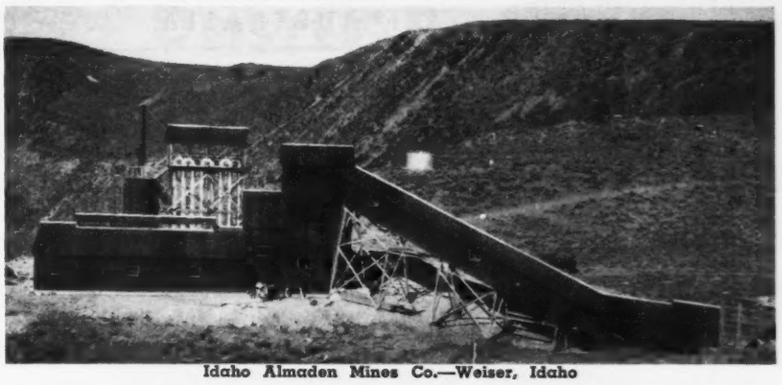
AUSTRALIA

Tin Production Starts At Renison Bell

Mine in Tasmania employs flotation and gravity methods in concentrating tin ore—Area in Victoria being tested for tin

▶ The plant of Renison Associated Tin Mines, N. L., Renison Bell, Tas., has commenced operations. The usual adjustments have been made, and results to date indicate that the method of treatment will be successful. The process consists of the flotation of the iron sulphides which accompany the tin, leaving the latter in the tailings, from which it is recovered later by gravity methods. When in full swing, 1,000 tons of ore weekly will be milled, from which a profit of 12/- per ton is expected.

▶ Ore reserves of Mount Lyell Mining & Railway Company, Ltd., Queenstown, Tas., at Sept. 30 were 10,458,000 tons assaying 1.52 per cent copper, 0.11 oz. silver and 0.015 oz. gold per ton. This represents a drop of 688,000 tons from the figure of a year earlier. Net cost of producing and realizing a ton of copper was £53-6-6 Aust. for the year, as compared with £52-5-3 for the preceding twelve months.



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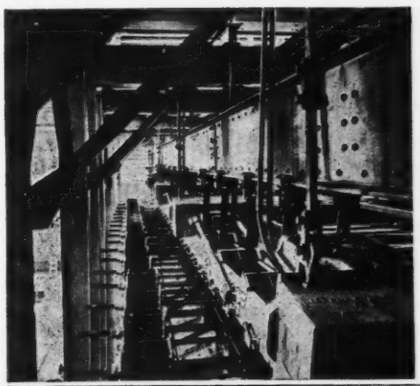

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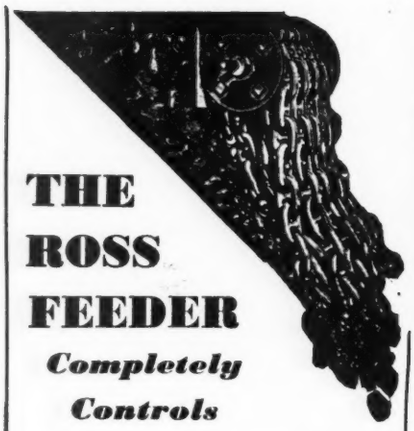

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▶AUSTRALIA

Western Australia

▶During the ten months to Oct. 31, Big Bell Gold Mines, Big Bell, near Cue, treated 368,162 short tons of ore for a yield of 49,929 fine ounces, an average of 2.7 dwt. per ton. For the last three months, an average of 40,000 tons monthly has been milled.

▶Blue Bird Gold Mines, N. L., at Norseman, expects to have its own battery operating during the first quarter. The plant will later be enlarged, should prospects warrant it.

▶Norseman Gold Mines, N. L., at Norseman, enlarged its scale of operations during the year ended Oct. 31. The figures for that year, as compared with the previous twelve months, are as follows:

Year Ended Oct. 31	1938	1939
Ore milled, short tons	86,414	107,147
Mill residues retreated, short tons	23,088	5,251
Gold, oz.	27,872	31,109
Dwt. per ton	6.45	5.80
Working costs, shillings per ton ore	29.15	30.3

The increase in tonnage and decrease in the grade of ore were primarily due to the treatment of a larger tonnage of ore from the low-grade Iron King deposit, which assays about 2.6 dwt.

Victoria

▶Sugarloaf Tin, N. L., which has a tin-sluicing property in Queensland, at present let on tribute, is testing an alluvial gold area at Landsborough, Victoria. It is stated that there is about 28,000,000 cu. yd. of wash in the area and that, if the testing work gives satisfactory results, the property will be equipped with a dredge.

▶Success of South Virginia in working the syncline between the Paddy's Gully and Derby anticlines at Eaglehawk (Bendigo) has stimulated interest in these formations, which have hitherto been neglected at Bendigo, and three old mines in the vicinity may be reopened with a view to investigating similar formations.

▶Operating a dump retreatment plant near Maryborough, Vic., Marysbury Gold, N.L., is now treating 10,000 short tons monthly. During the three months to Sept. 30, recovery was 586 oz., or 9.2 grains per ton. Residues assayed just over a grain. Although a good performance both technically and economically—costs were 2/9 Aust. per ton—other dumps to be treated later are of higher grade.

New South Wales

▶Lake George Mines, Ltd., Captain's Flat, N. S. W., reports an operating loss of £A27,578 for the quarter ended June 30. During the period, 33,000 tons of ore were treated for a recovery of 4,014 tons of zinc concentrate, assaying 55.9 percent zinc. Output of lead concentrate is not stated. Neither the tonnage treated nor the metallurgical results have yet come up to expectations and the company's difficulties have been accentuated by low metal prices and by a shortage of shipping.

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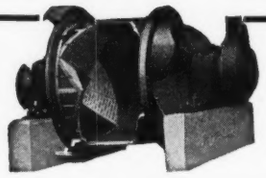

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Fiji

▶Net profit of Loloma (Fiji) Gold Mines, N. L., Tavua, Fiji, for the year ended July 31 was £193,814 Aust., compared with £83,793 in the previous year. Ore treated amounted to 27,767 long tons, which yielded 37,208 fine oz. Head value was 28.1 dwt. and extraction 95.2 per cent. Ore reserves at Sept. 6, consisting of 141,549 tons containing 175,862 oz. gold, are some 2,000 oz. less than the figures of the preceding year. Development work on the No. 3 (324-ft.) level has indicated the continuance at that level of the favorable features of the levels above, and it is planned to sink the Theodore shaft another 200 ft. to No. 5 level and to test the lode by shaft crosscuts at Nos. 4 and 5 levels.

▶The adjoining Emperor company showed an even greater increase in profit, from £71,541 for the year ended June 30, 1938, to £204,288 for the 1939 fiscal year. Tonnage treated was 178,941 tons, and gold recovery 52,393 oz., grade averaging 6.5 dwt. Total ore reserves at Sept. 6 were 839,000 tons, a small drop of about 7,000 tons on the year. Development work on Nos. 3 and 4 levels has given encouraging results, and high values have been encountered in places, particularly where shattered and highly mineralized formations have been met. It is expected that a good tonnage of payable ore will result from these developments. Mill additions to take care of the sulphide and semi-sulphide ores are to be undertaken shortly.

EQUIPMENT

(*Continued from page* 99)

Equipment Company, Denver, Colo., recently developed a portable placer unit which incorporates the use of the Denver mineral jib. A device for reducing wear of bucket pins on gold dredges was put into service in 1939 by the Taylor-Wharton Iron & Steel Company, High Bridge, N. J.

WELDING—Simplicity, compactness, and ease of operation are features of equipment now being offered by manufacturers of electric welding units. Harnischfeger Corporation, Milwaukee, Wis., announced its new WA-200 welder with a range from 40 to 225 amp. that requires little space. The Lincoln Electric Company, Cleveland, Ohio, announced a new diesel-engine-driven arc welder featuring a compact hand-cranked starting unit. Linde Air Products Company, New York, N. Y., introduced its W-26 welding blowpipe for heavy-duty oxy-acetylene work and the W-29 blowpipe for lighter operations. Hewitt Rubber Corporation, Buffalo, New York, brought out its new Twinweld welding hose to convey oxygen and acetylene for welding and cutting work. General Electric reported a new 300-amp. arc welder driven by a four-cylinder Caterpillar diesel engine, with starting engine and clutch.

SMELTING—Interesting advances occurred in the design and controls of electric smelting furnaces. General Electric Company, Schenectady, N. Y., introduced its Reactrol control for regulating electric furnace temperatures automatically. The Monarch Engineering & Manufacturing Company, Baltimore, Md., brought out an improved and new line of metallurgical cupolas for smelting ores and concentrates.

SAFETY FIRST—A trend in auxiliary mine ventilation is the air filtration of the air handled by fans as a protective measure in combating silicosis. Coppus Engineering Corporation, Worcester, Mass., announced its Unit air filter for collecting silica dust in high concentration. The Midget Impinger, a new light-weight portable dust-sampling apparatus of the Mine Safety Appliance Company, Pittsburgh, Pa., was brought out for a simple and quick method of collecting samples of mine air. The company's microprojector was offered for rapid and accurate counting of dust particles. E. D. Bullard Company, San Francisco, Calif., announced its improved Morenci Safety belt and MT mouthpiece type mask for use in smelters. Western Precipitation Corporation, Los Angeles, Calif., reports the development of a hygienic precipitator in which the dust is precipitated onto a moving

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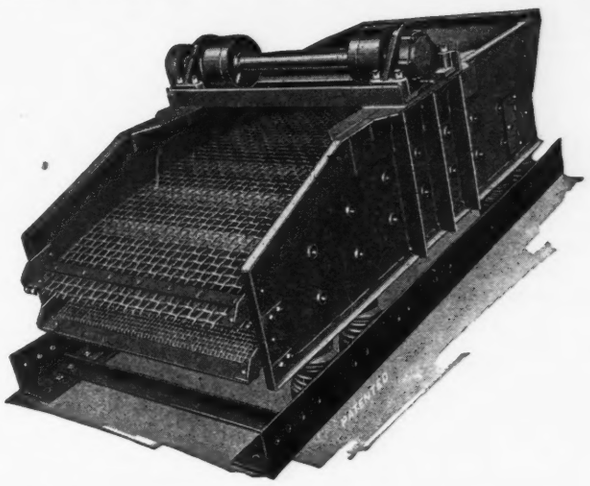
VIBRATING SCREEN FOR ORE



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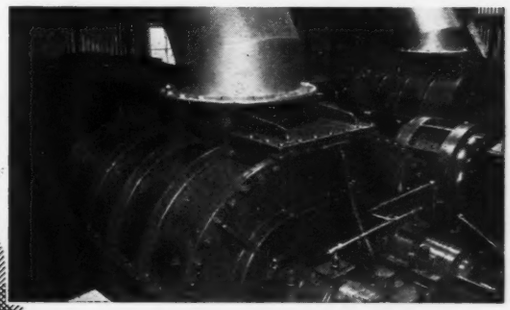
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Roots CONNERSVILLE
BLOWER CORPORATION
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film of water. General Electric Company, Schenectady, N. Y., announced a light-weight portable X-ray unit and a photo-roentgenographic equipment for diagnostic radiograph for chest surveys.

YUGOSLAVIA

Trepca Mines Operating At Capacity

Progress during year is effected by labor strike and European war, but development continues and drilling reveals prospects for more ore in depth

▶ Trepca Mines has at last had an unfavorable year. The war increased shipping facilities for a while, exchange difficulties arose, a strike closed the Stantrg mine for six weeks, low metal prices continued to rule, and taxation increased heavily in both Britain and Yugoslavia. Despite all this there was a net profit of £40,091. No dividend will be paid for the year. All the difficulties except higher taxes have been overcome. The mine is now operating at capacity. An arrangement has been made to sell a portion of the production to the Yugoslav government, thus providing the Yugoslavian currency needed to pay operating expenses in that country and obviating differences in exchange. Developments in the Stantrg and other mines have continued satisfactory. Better prices are being obtained for lead and zinc concentrates. The first hearth of the new lead smelter is in operation. Though construction has been delayed by slow deliveries of materials, construction is proceeding. The outlook for the present year is favorable to improved earnings. Diamond drilling of the ore at depth has revealed conditions which have prompted the management to sink the shaft and open up a new level. On the bottom level 7,911 square meters of ore has so far been developed averaging 8.72 per cent lead, 3.4 per cent zinc, and 5.5 oz. of silver per ton. Ore reserves, though not recalculated, were fully maintained by new developments.

Silesian-American Corporation Reports

▶ When the German army invaded Poland in September the zinc properties of the Silesian American Corporation lying 50 miles east from the Oder River in Germany, to Olkusz in what was formerly Poland, were taken over by a German Commission. The latest status of these properties is mentioned in a recent report by the company as follows:

As indicated in statements issued in September, 1939, by Silesian-American Corporation, it was advised prior to the German occupation of Upper Silesia that the Polish Government placed the properties of said Corporation's subsidiary, Giesche Spolka Akcyjna, under military control, and shortly after the occupation of Upper Silesia by Germany said Corporation was further advised that possession of such properties was taken by a Commissar appointed by the German Government. During such possession no income has been received by Silesian-American Corporation from its said subsidiary. It is impossible to conjecture how long this situation will continue. Silesian-American Corporation has outstanding $2,510,500 principal amount of its 15-year 7 per cent Collateral Trust Sinking Fund Gold Bonds due Aug. 1, 1941. The next maturing coupon on these bonds is due Feb. 1, 1940, and involves an aggregate interest payment of $87,867.50. The bonds are secured by all the stock of the subsidiary, Giesche Spolka Akcyjna, together with a fifteen-year note of the subsidiary in the principal amount of $4,333,334, and also $2,400,000 principal amount of bonds of a German company, Bergwerksgesellschaft Georg von Giesche's Erben, secured by a mortgage on certain property in Germany owned by the German company. Due to exchange restrictions interest and sinking-fund payments accruing after Nov. 1, 1937, have not been made by the German company on its bonds. Under the existing circumstances the board of directors of Silesian-American Corporation considers it advisable to pay the Feb. 1, 1940 coupon. Payment of the interest due Feb. 1, 1940, should not be taken as an assurance that interest coupons due Aug. 1, 1940, and subsequently will be paid. On the other hand, this notice should not be taken to indicate that such future interest will not be paid. The continued payment of such interest will depend upon conditions in Europe, the outcome of the war, exchange restrictions, and other conditions which cannot now be foreseen.

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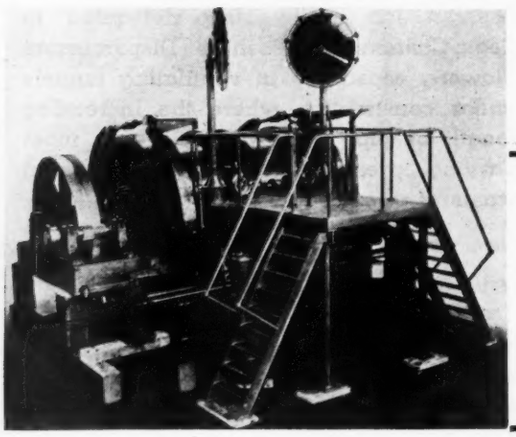

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